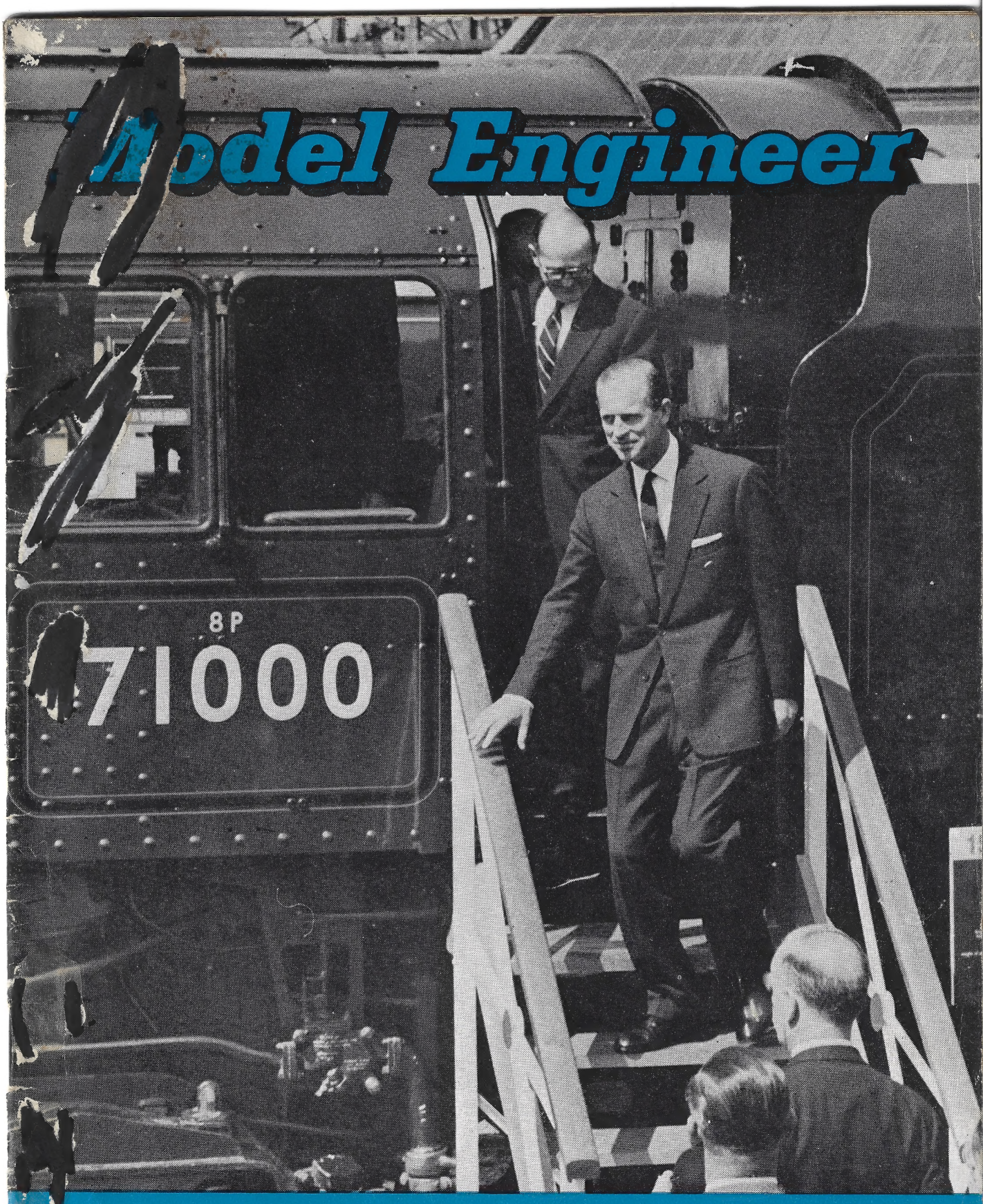
Model Engineer



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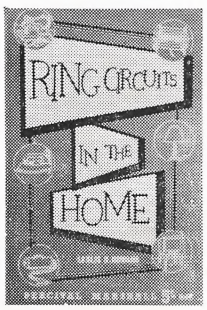

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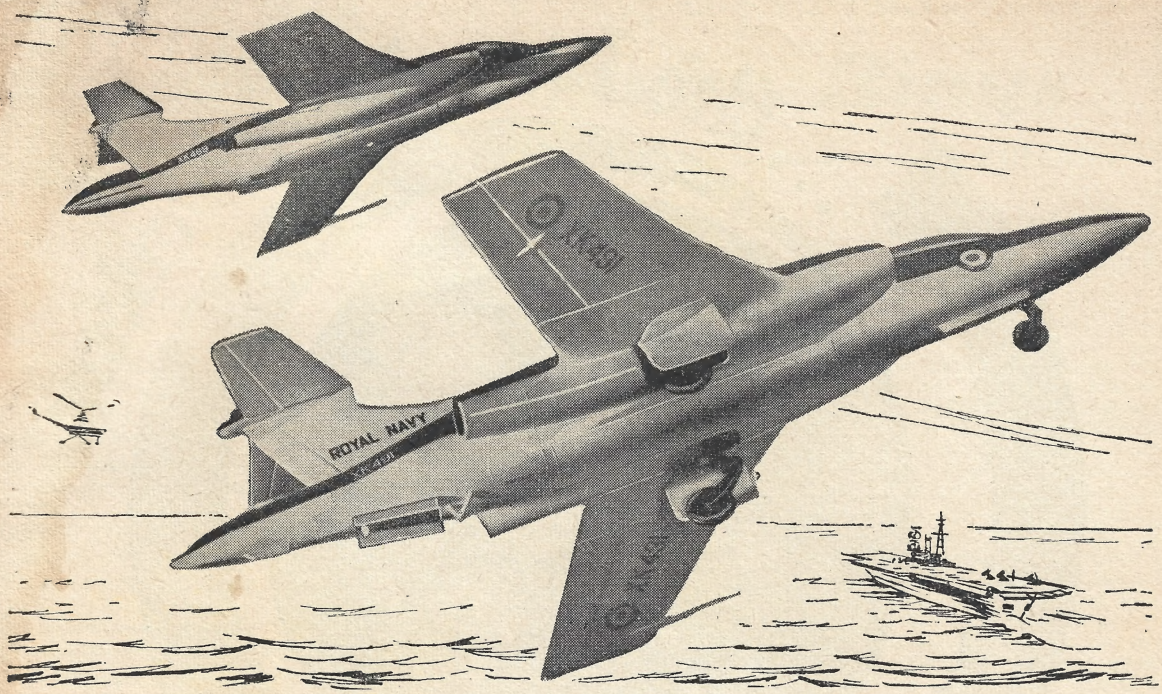

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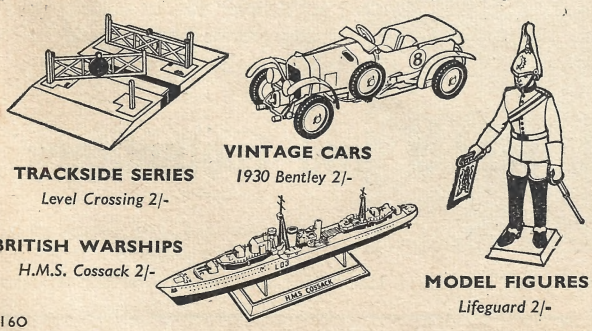

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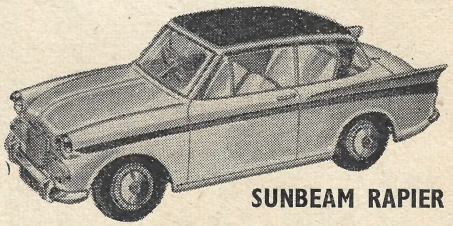

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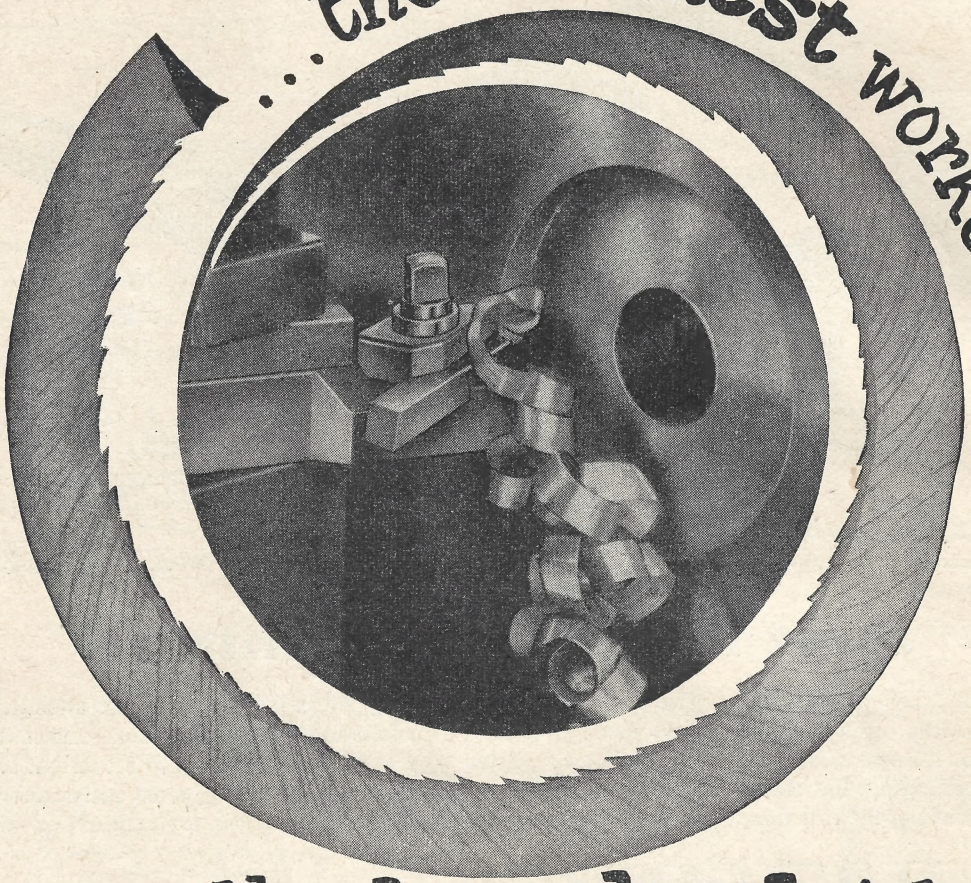

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Model Engineer

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COVER PICTURE

The Duke of Edinburgh, who has given his name to the premier award of the Model Engineer Exhibition, pictured at Marylebone when he toured the exhibition commemorating the golden jubilee of the Institution of Locomotive Engineers. Robert Fleming reports on pages 763.

ONE SHILLING · 22 JUNE 1961
VOL 124 · NO 3128

Published every Thursday
Subscription 65s. (USA and Canada $9.25), post free

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A WEEKLY COMMENTARY

Smoke Rings

By VULCAN

MARTIN EVANS and I spent a happy day recently with Mr H. Buckle, assistant production manager of the apprentices' training department at Fords.

The invitation arose when Mr Buckle was searching for an article in MODEL ENGINEER which describes the erection of a locomotive testing stand.

He is a keen model engineer with several fine models to his credit. One of his latest—which we hope to see at the Exhibition in August—is a 5 in gauge version of Joseph Beatie's *The Clyde* built in 1861.

Exhibition

Every two years Fords stage an exhibition of freelance work which the apprentices have done in their spare time. The next show will be in January and Mr Buckle was asked to exhibit his new model locomotive. It would be a good idea to have it running, the organisers told him.

Mr Buckle pointed out the impossibility of running a 5 in. gauge engine on a tiny track in a small exhibition room, but promised to put it on a testing stand.

The elusive article

When he came to look for the relevant article it proved elusive. Though he has read our magazine for years, and though Fords library has a complete set of MEs from No 1, it was not possible to trace it.

In desperation he telephoned our office and we were able to help him. In return he invited Mr Evans and myself to look round the apprentices' workshops, which can accommodate 400 lads, and to make a short tour of part of the vast Dagenham works.

The apprentices at Fords are not indentured but nevertheless a great many of the boys elect to stay with the company, a high proportion of them going to the toolroom, pattern-making, and experimental shops.

There is a set programme of exercises, after which the projects become interestingly varied. Making

Is there a future Henry Ford among these lads in the Ford apprentice workshops at Dagenham? This shop, housing grinders, lathes, millers and shapers is just a part of the apprentice training department

simple jigs for the toolroom and preparing cut-away engines and mechanisms for exhibition purposes represent the wide range of tasks.

The lads are encouraged to exercise their minds and to undertake whatever technical research is necessary. To assist them there is a well-kept and well-stocked library, in which MODEL ENGINEER has a prominent position.

Adventure courses

Attention is given to character building so that at an early stage those with instinctive qualities of leadership may be groomed for responsibility. Groups are sent on Outward Bound courses to help in assessing the boys' characters.

Fords scheme is undoubtedly a good one and I feel that some measure of its success lies with Mr Buckle, the keen model engineer who has given his skills to this great company for over a quarter of a century.

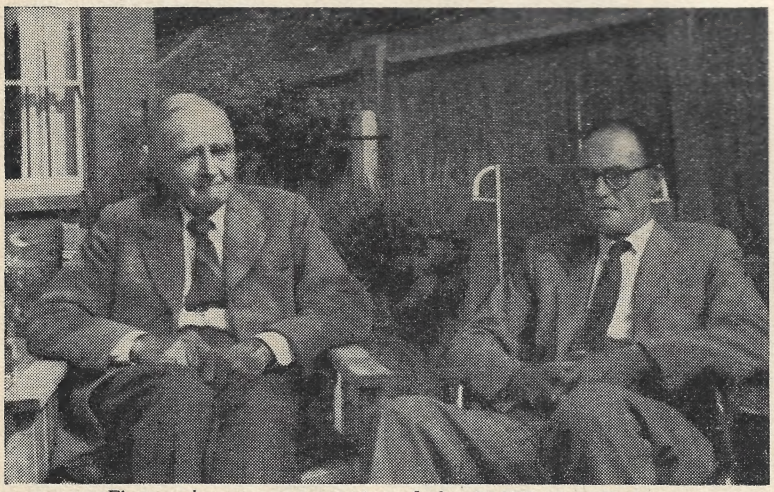
Incidentally, Mr Buckle thought up another poser while we were there, but this time we could not give him the answer. The problem: the livery of Joseph Beatie's *The Clyde* ?

Secretaries meet

IT was 63 years ago that MODEL ENGINEER was born. A few months later the Society of Model and Experimental Engineers was formed and one of its founder members and first secretary was Mr Herbert Sanderson.

About a year ago Mr Sanderson met with a road accident and sustained a broken leg. When you are on the wrong side of three score years and ten, broken bones do not knit so readily, but I am happy to report that Mr Sanderson is mobile again and recently travelled to Eastbourne to spend a short convalescence with his sisters.

It was an opportunity to meet the present secretary of the SMEE, the industrious Mr S. L. Sheppard, who lives at Hampden Park, Eastbourne, but he was out when Mr Sanderson called. But Shep, as he is familiarly dubbed, was only taking the dog for a walk. You may imagine his surprised expression when, nearing home, he met Herbert Sanderson leaving his front gate.



First and present secretaries of the SMEE. Mr Herbert Sanderson (left) with Mr S. L. Sheppard, in the latter's garden

Next week

Oliver Smith, ME staff writer and author of the successful series on the model tug MOORCOCK, *writes of* HIBERNIA, *which until its recent withdrawal was the oldest ship-towing tug on the Thames.*

Mr Sanderson shares with Mr A. M. Yule, who lives at Bushey, near Watford, the distinction of being the sole survivors of the founder-members of the SMEE.

Be-switched

THE old buildings opposite our premises in Noel Street, on the edge of Soho, have been demolished to make way for a new office block.

Pneumatic drills are tearing at the remnants of the foundations, mechanical shovels are scooping up buckets of earth, and heavy lorries roar on and off the site every few minutes. Yet this din is nothing to the uproar caused by a letter in Postbag of June 8 which quietly transferred a Claud to the Great Western Railway.

The editorial excuse for letting this go by ? We were still dazzled from a lunch-time look at the vivacious Jacqueline Kennedy driving down The Mall !

CHUCK . . . **. . . THE MUDDLE ENGINEER**

FIFTY YEARS WITH THE RAILWAY ENGINE

Under a decorated arch the engines stand in two lines. Midland Compound No 1000 heads the right-hand column and "Evening Star" (the 999th) the other

When the Institute of Locomotive Engineers celebrated its Golden Jubilee, ROBERT FLEMING went to a special exhibition held in its honour

As the Institution of Locomotive Engineers was founded in 1911, this year is its Golden Jubilee. The anniversary has been happily celebrated with the Duke of Edinburgh taking part in the role of engine driver.

A programme organised by the committee of the Institution included a day trip to the West Country, enjoyed by members and their guests; the Sir Seymour Biscoe Tritton Lecture delivered by the retiring chairman of the British Transport Commission, Sir Brian Robertson; and an exhibition of locomotives and rolling stock which the Commission had specially arranged at Marylebone Goods Station.

The Institution was further honoured by the presence of the Duke of Edinburgh who made an inspection of the exhibits, and drove a train hauled by a diesel-hydraulic Type 4 locomotive (Warship class) from Marylebone to Windsor.

While all these events were for members of the Institution and their guests, the exhibition at Marylebone remained open for two days after the official celebration had ended. This enabled the general public, who are keenly interested in our railways, to see some of their old favourites side by side with the modern engines.

Four steam locomotives each claimed a particular distinction. The locomotives were lined up in two columns with two steamers at the head. Looking a picture in her old company colours at the head of Route A was the 4-4-0 Midland Compound No 1000, built in 1902 by S. W. Johnson and the sole survivor of some 200 which were in service. She is one of those scheduled for preservation, and so when she ends her days on the track we will still be able to examine her in the Clapham Museum. I was fascinated by the welding on one of the spokes of the left-hand driving wheel and wondered what story lay behind it. Perhaps when No 1000 is ready for her last resting place the weld will be ground down to be uniform with the spoke.

Hard up to the tender of the Midland Compound was the celebrated *Mallard*, Sir Nigel Gresley's masterpiece. She looked superb, and it was good to know that she was scheduled for preservation. We were able to study the parts that make her tick and to have a chat with Driver Bray, the man who was at the controls on the day in 1938 when she took the world record for steam traction of 126 m.p.h.

To move from Mallard to the next engine; to travel from the past to the present. Here was a Type 1 800 h.p. diesel-electric locomotive for the Eastern Region of British Railways. It was built by the North British Locomotive Co. Ltd and powered by a Paxman 16Y4XL diesel engine with transmission and control equipment by the General Electrical Company. As one of ten locomotives (Nos D.8400-D8409) intended primarily for freight hauling, it has not been fitted with train heating equipment.

Next in line was a Type 2 1,365 h.p. mixed traffic diesel-electric locomotive from the Brush Electrical Engineering Co. Ltd. A Mirlees J.V.S. 12T diesel engine rated at 1,356 h.p. supplied the power to the locomotive on show, but others in the class have their engines rated at 1,250 or 1,600 h.p. They are intended mainly for the Eastern Region, working passenger and freight services. The Brush Type 2 (D5500-D5699, D5800-D5825) shows what a diesel can look like and proves that a modern locomotive does not necessarily have to be ugly.

A Type 3, on show, a mixed traffic diesel electric of 1,550 h.p., was produced by the Birmingham Railway Carriage and Wagon Company Ltd with a Sulzer 8LDA28 diesel engine and Crompton Parkinson electrical equipment. Lovers of steam often point out that even the diesels cannot escape entirely from generating this form of power as it is required for train heating. But they may soon lose this argument because train heating is also due for a change. The Type 3 has electric heating equipment so arranged that when the power is not needed for heating it can be used for traction. Ninety-eight of these locomotives (D6500-D6597) have been ordered to replace the steam locomotive on the Kent Coast scheme of the Southern Region.

We saw a main-line diesel electric made in the British Railways workshops and classed as British Railways Type 4. It was powered by a 2,500 h.p. Sulzer 12LDA28 diesel engine and has Crompton Parkinson electrical equipment. At present 137 of these units (D1-D137) are under construction in the workshops at Crewe and Derby. They are to go into service on the London Midland Region.

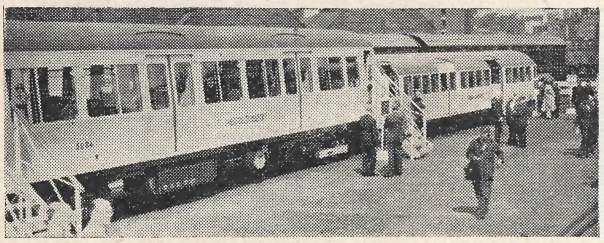
Near the end of the first line stood one of the better-

known classes of main-line diesel electrics, the 3,300 h.p. Deltic manufactured by the English Electric Company and powered by two 1,650 h.p. Napier-Deltic high speed diesel engines. They are the largest single units on British Railways. Twenty-two of them are intended to replace 55 steam locomotives hauling such well-known expresses on the East Coast route as the Flying Scotsman, The Elizabethan, The Talisman, The Yorkshire Pullman and The Tees-Tyne Pullman.

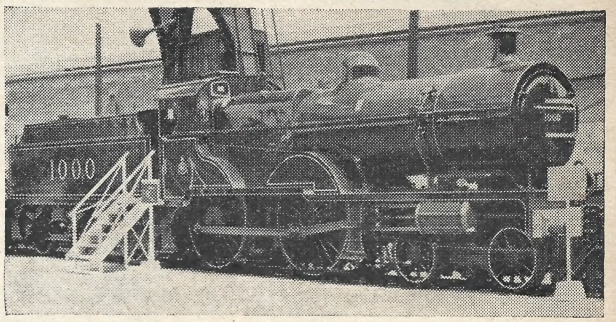
The last in the line gave us our first chance to study a British Railways Type 4 diesel-hydraulic—the 2,200 h.p. Warship class locomotives for the Western Region. All 71 (D800-D870) will be named after warships, with the exception of D800 which carries the name of *Sir Brian Robertson*. It was the Warship class *Magpie* which the Duke of Edinburgh drove to Windsor; the name coincided with that of the ship in which he served.

Power is supplied from two Maybach MD650 diesel engines to two Mekydro K104 hydraulic transmission units. A variation of this equipment in the locomotive on show resulted in an extra high floor in the driving cab. If it becomes standard, we shall sympathise with the driver of generous build !

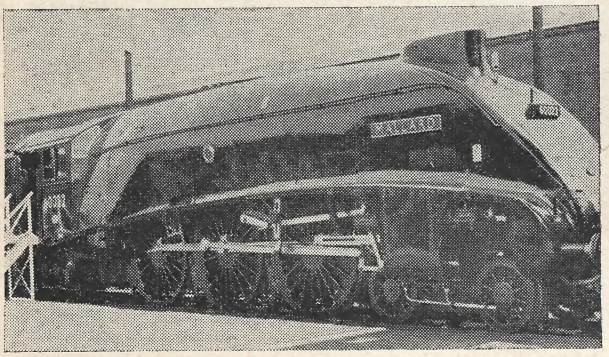
Crossing over to the other line and working our way back to the head of the column, we were confronted with something different—two of the latest types of driving-motor cars for London Transport Underground Railway. The first to claim our attention was the London Transport tube coach now coming into service on the Central and Piccadilly lines.



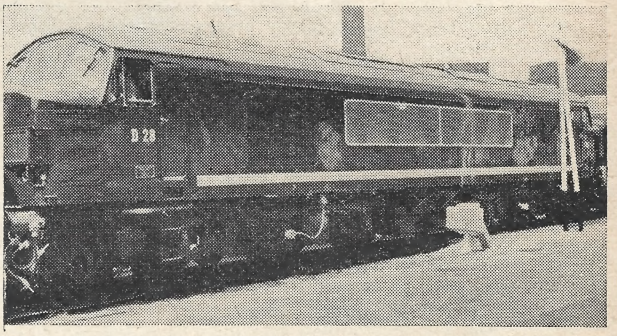
Two driving-motor cars for London Transport. The larger one is for the Metropolitan and the other is for the Piccadilly and Central lines



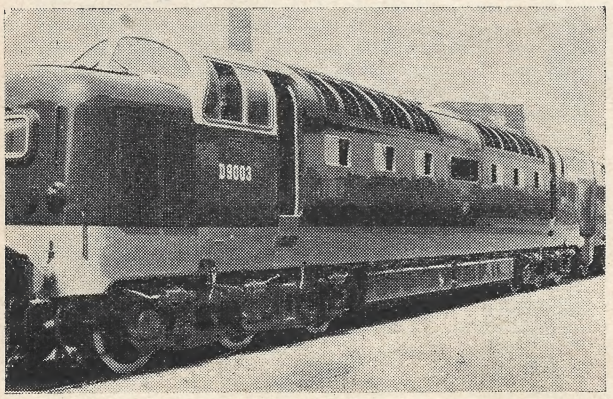
Class 4P Midland Compound No 1000 weighs, with tender, 104 tons. It has Stephenson valve gear



" Mallard " the renowned



BR Type 4 2,500 h.p. main-line diesel electric No D28, 1-C-C-1, 136 tons, top speed ninety

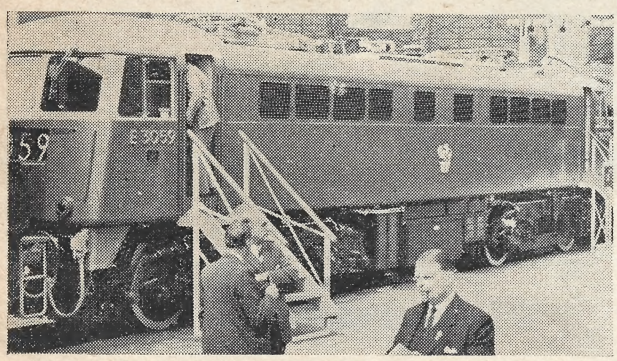


This 100-ton Deltic can go at 100 m.p.h.

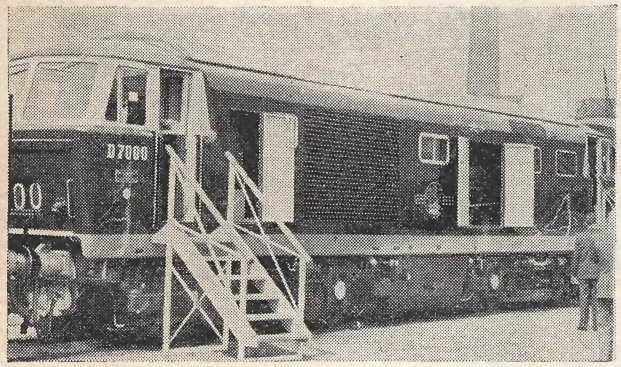
Nearly all the body is used for carrying passengers. Only a small section is parted off as a driver's cab, and all the electrical equipment is neatly tucked away between the frames.

The other driving car, destined for the Metropolitan Line, differed mainly from its neighbour in the larger body permitted by the larger tunnel. It had a seating capacity for 54 passengers, 12 more than the tube coach.

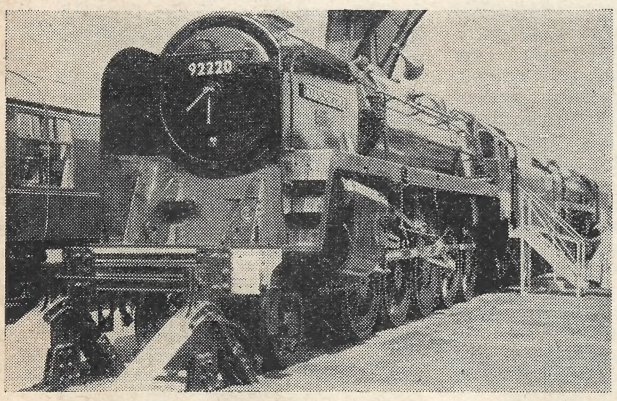
Right to left: BR 3,200 h.p., 25 kV a.c. electric main-line locomotive No E3059; English Electric gas turbine GT3; Beyer Peacock diesel hydraulic No D7000; 8P "Duke of Gloucester"; and "Evening Star"



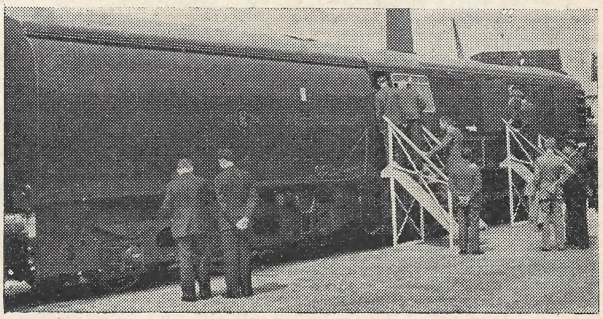
English Electric gas turbine GT3 can carry 2,000 gallons of fuel oil and 1,750 gallons of water



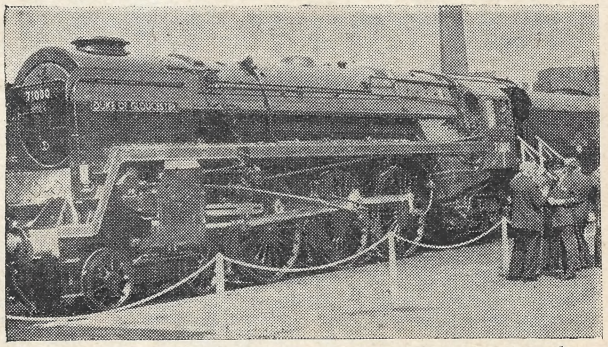
No 71000 "Duke of Gloucester"



BR 3,200 h.p. electric main-line engine E3059



Beyer Peacock (Hymek) Type 3 diesel hydraulic



Sunset of steam: No 92220 "Evening Star"

We saw the first of the electric locomotives, the 2,500 h.p. d.c. electric main-line unit for the South-eastern Division of the Southern Region. It was one of 14 locomotives (D5000-D5013) being built in the workshops of British Railways at Doncaster and is designed to handle freight trains of 1,000 tons over heavily graded routes.

Another electric locomotive from the same works, the 3,200 h.p., 25 kV a.c. electric main-line engine, was one of a hundred being produced (40 at Doncaster and 60 by contractors) to work the electrified line of the London Midland Region from Euston to Manchester and Liverpool.

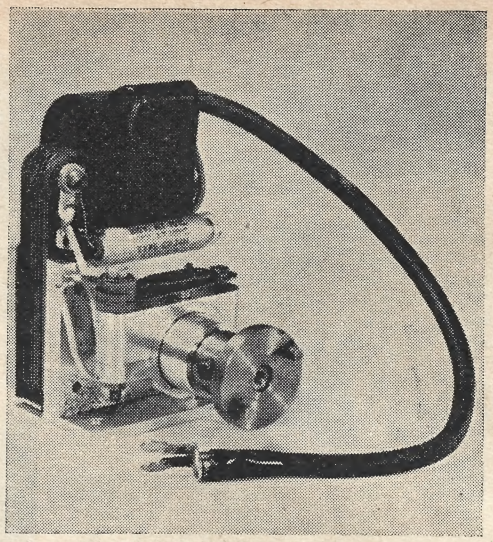
The English Electric 2,700 h.p. 4-6-0 gas-turbine locomotive GT3 in outward appearance was not unlike a streamlined steam engine, with a similar wheel arrangement and was quite a break away from the general pattern of the diesels and electrics. It was still in the experimental stage and was undergoing trials on the London Midland Region before operating over the old Great Central line between Marylebone and Nottingham.

We came to the Beyer Peacock (Hymek) Type 3 1,700 h.p. diesel-hydraulic, one of 95 being made for

Continued on page 779

ATOMAG MINOR
MARK IX

Writing of the miniature magneto from long practical experience, EDGAR T. WESTBURY discusses some of the various arrangements



ADAPTING the Atomag

BESIDES the methods of mounting and driving the Atomag Minor which I have mentioned in earlier articles, there are several other ways in which it can be adapted to suit particular engines. For an engine of small size, say 5 c.c. with a shaft not larger than $\frac{5}{16}$ in. dia. at the driving end, the magnet may be used, partly or completely, to serve as the flywheel; the stator and coil may then be mounted on a flange attached to the main bearing housing. The contact breaker may be fitted at the blind end of the crankcase, driven by a follower crank, or between the stator and crankcase.

For the latter, the type of breaker shown in the detail drawings on page 651 on May 25 is appropriate; note that in forming the cam on the shaft, its angular location must be related to that of the crankpin so that, when the bracket is in the fully retard position, contact is broken at top dead centre.

An interesting adaptation of the Atomag has been fitted to the flat twin engine built by Mr Bruce Harris of Bristol SMEE for his 5 in. gauge locomotive, and described in ME last year. At that time, it was equipped with battery and coil ignition, using a contact breaker running at crankshaft speed on a spur-geared horizontal shaft, and a h.t. distributor driven therefrom at half speed on a vertical shaft by bevel gearing. This somewhat unusual arrangement was to some extent dictated by the design of the particular engine (see pages 694-6, ME 9 June 1960).

In adapting the engine to magneto ignition, it was only necessary to extend the horizontal shaft to take the rotor magnet, and to sandwich the stator between the distributor housing and the contact breaker casing, which was displaced endwise a little over half an inch. No alteration to the h.t. distributor and its gearing was necessary; the magneto coil was connected in the normal way on the l.t. side, and its h.t. tag was connected to the input terminal of the distributor. With the original cam in the contact breaker, the magneto produces one spark per revolution of the engine; this is fed to the distributor and, in turn, to each of the sparking plugs, on the respective firing strokes of the two cylinders.

Engines of any type which are already fitted with their own contact breaker and distributor (or one of the two) may use this equipment in connection with the rotor and stator of the Atomag, suitably mounted and coupled or geared. It is essential in all instances that the rotor should be properly timed in relation to the contact breaker, and that a condenser of the size specified should be connected across the contact points, as close to them as possible. Where constructors in the past have failed to obtain satisfactory results with the original Atomag Minor or its variants, the reason, more often than not, has been lack of observance of these simple rules.

One or two further notes on the construction of the Mark IX may be welcome. The laminations on the face of the body casting may be used, when they are being located, as a jig to mark or spot the positions of the tapping holes. To get the utmost accuracy in the concentricity of the pole faces, they may be machined in place by mounting the assembly on a mandrel (before the bushes are inserted in the bearing housing), or chucking it in any way which will set the bore to run truly, and skimming the faces with a boring tool. This operation must, of course, be done with the coil in position, as it is not desirable to dismantle and reassemble the laminations afterwards.

If, for any reason, the operation is not practicable or convenient, the laminations may be located slightly further apart to avoid the need for machining the pole faces. Here a dummy rotor should be made, about 0.010 in. larger in diameter than the magnet, and mounted truly on the rotor shaft, or equipped with a concentric spigot to fit the bore of the housing. The laminations are clamped in close contact each side of the dummy, and holes are located from them as before.

As an alternative to 5 BA studs and nuts to secure the stator laminations, $\frac{1}{8}$ in. Whitworth may be used; they should be of mild steel, but the nuts which secure them, and also those for the end shield, may with advantage be of brass, to cut down parasitic magnetic effects as much as possible.

In making up the blade-spring type of contact breaker, it will be found that the spring steel supplied is just soft enough for a sharp drill, though it may be difficult to centre-punch it with a tool of normal temper. Dental burrs make quite good drills for hard materials where only shallow holes

are required and the rate of cutting is not important.

The holes for anchoring the springs, and to take the contact rivets, may be spotted from one blade to the other to ensure alignment. Some care is necessary in fitting the tungsten tipped rivets; they should not be too loose, and a pad of soft aluminium or copper should be used to rest them on in burring over the ends, to avoid the risk of cracking the tips. As an alternative to riveting, they may be soldered in; avoid using excessive heat which might draw the spring temper. The only essential thing is to fix the contacts securely with good electrical contact.

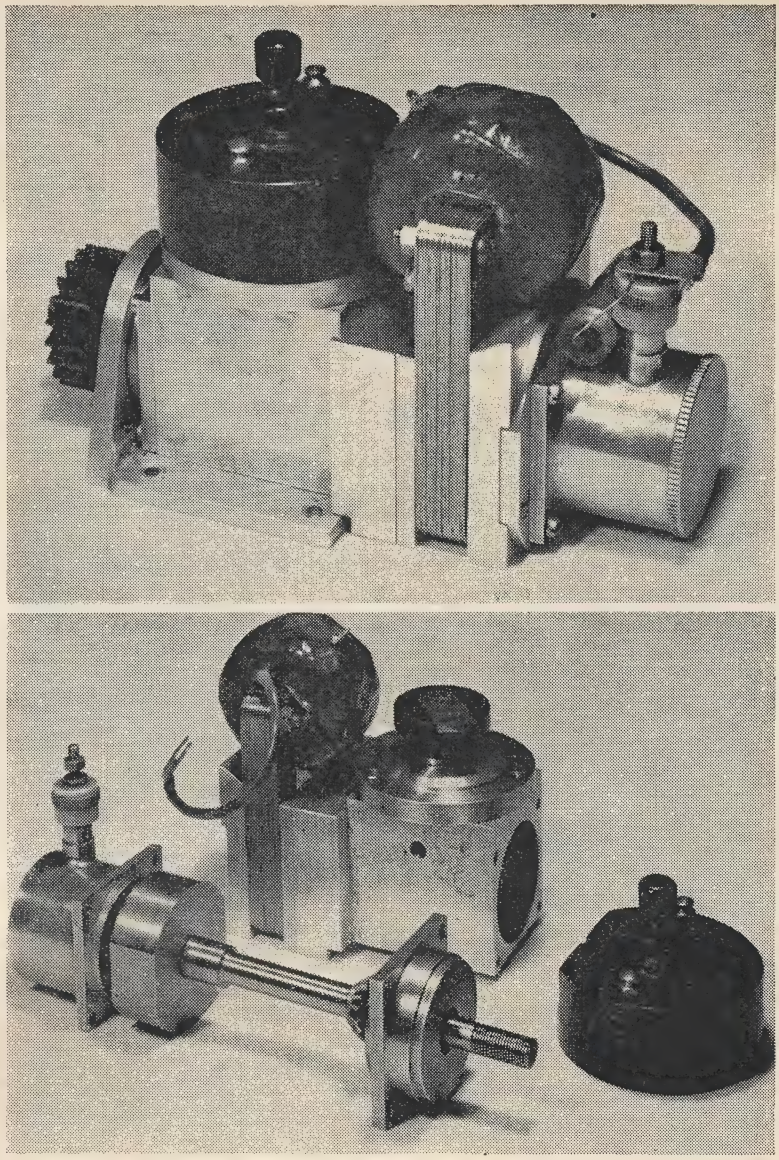
In fitting the springs to the bracket, the lower one should be bent slightly upwards, and the top one downwards, so that they normally close with firm pressure. Take care that the top spring is properly insulated from the bracket and the securing screw, by the fibre bushes and washers.

It will be noted that the top spring is narrowed near its fixed end; the object is to ensure that it flexes from this point while the contact end remains relatively rigid. Many constructors who have made similar contact breakers of my design have failed to observe this detail, with the result that the spring bends just wherever it feels inclined to do so, and does not necessarily make a clean break at the contacts. A solder tag, or similar strip of metal, may be used to connect the top spring to the live leads of the coil and condenser.

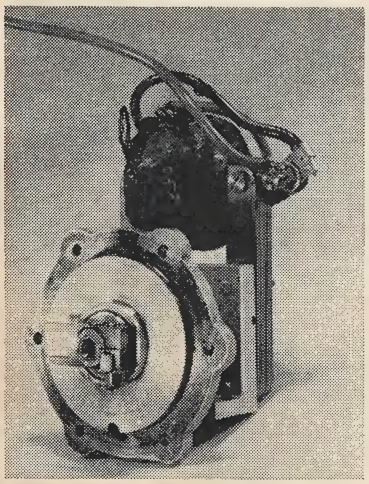
The fibre push rod should be an easy fit in the bush of the bracket; make sure that it does not foul in the clearance hole of the lower spring blade. Its length may call for some adjustment for the top blade to be fairly parallel with the lower one and the contacts to meet squarely when in the closed position.

It is, of course, quite practicable to use other forms of contact breakers with the Atomag, but light action and low inertia are desirable, to say the least, for all small high-speed engines. Some breakers which I have seen are capable of absorbing far more than their fair share of engine power without being certain in their action at high speed.

I am often asked how much power is absorbed by a miniature magneto. Many readers are afraid that by fitting a magneto to a small engine, the useful performance of the engine may be diminished, as it is obvious that even the smallest electrical generator must take *some* power to drive it. This question is a very difficult one to answer in definite terms, because so much depends on



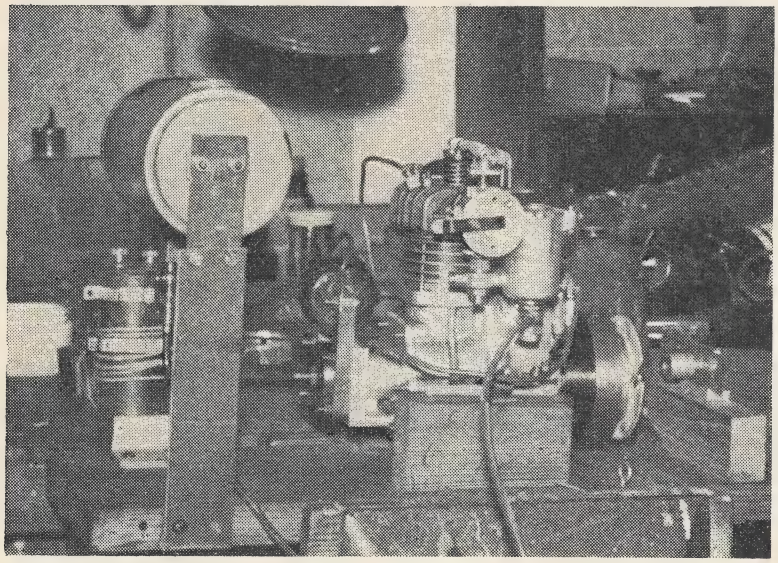
Top: Atomag Minor, adapted to work with vertical distributor on the flat twin built by Bruce Harris of Bristol SMEE. Above: Here the same magneto has been dismantled to show the component parts



With this new endplate and follower crank, the Atomag can be adapted to direct drive on the Dolphin engine

the magneto and the way that it is coupled or geared to the engine. Moreover, exact tests of small engines are by no means easy to carry out, because there are many factors which affect power output at any particular time, and it is often found that where a number of test runs are made no two of them produce the same results.

I am convinced from my own experience that a well-designed miniature magneto, direct-coupled to a small engine, absorbs very little power indeed, so long as it is perfectly aligned and all sources of friction are eliminated as far as possible. Errors in this respect, or the use of gearing of dubious efficiency, may absorb a great deal of power.



The Dolphin engine built by well-known power boat enthusiast, Mr R. O. Porter, awaits a bench test

It may seem an anomaly—even an impossibility—but some of my engines have produced more power with magneto ignition than with battery and coil. In a number of tests made with the 6 c.c. Atom Minor Mark III engine driving a 13 in. airscrew, the maximum speed with coil ignition was approximately 6,000 r.p.m., and with the Atomag Minor 6,250 to 6,400 r.p.m. This is difficult to account for on theoretical grounds, but I have had similar reports from other users of both full-size and miniature engines.

Many tests of ignition apparatus which have been carried out in laboratory conditions *appear* to show that it does not matter how a spark is produced. It was recently stated that, in tests of an engine fitted with apparatus which enabled the spark voltage to be gradually reduced, no decrease in performance was recorded, up to the point where the spark actually failed to cross the sparking plug gap. I do not question the authenticity of these tests, but I am not convinced that they tell the whole story of ignition efficiency. Nevertheless, I agree, emphatically, that this is not determined directly by the amount of voltage or current expended in producing the spark.

One of my friends who carried out some careful tests some years ago told me that the contact breaker (which is necessary both for coil and magneto ignition) absorbed more power at high speed than the rotary magnet of the Atomag Minor. This agrees with my own conclusions, but of course a great deal depends on individual circumstances, such as those to which I have already referred. A magneto designed to produce a high output in terms of actual wattage in the primary circuit would undoubtedly require appreciable driving power, and this points to the advisability of designing small magnetos to operate with the utmost magnetic and electrical economy.

I have also been challenged on my statement, made some time ago, that "there is nothing to beat a good magneto." If that is so, I am asked, why is it that many racing motorcycles employ coil ignition ? First of all, it should be explained that the statement is taken out of context; it was used of non-racing miniature engines, and was intended to emphasise reliability rather than racing performance. But even there, I still have great faith in a good magneto, suitably designed for the particular job it is called upon to perform.

The reasons why the designers or users of racing motorcycles may prefer to use coil ignition may or may not be logical, but it is quite likely that standard types of magnetos are not capable of giving satisfactory performance at the speeds attained by specially tuned engines. So far as I know, there are no special racing magnetos which could readily be applied to some of the modern engines, and adapting existing magnetos may be difficult or impracticable.

On the other hand, it is fairly easy to boost coil ignition systems with little or no structural alteration to the engine, whether it is originally designed for coil ignition or not. The use of special or over-energised coils, or (for multi-cylinder engines) multiple contact breakers, or individual coils for each cylinder—all these expedients are obvious, on the principle that any nut can be cracked if one uses a large enough hammer ! But that, I respectfully submit, is not the way that real efficiency lies.

In the next article I propose to describe a class of magneto specially suited to multi-cylinder engines, and just as easy to construct as the Atomag Minor. ▣

LATEST LOCOMOTIVE NEWS

THE E2 class 0-6-0Ts of the LBSCR were introduced by Lawson Billinton in 1913. Later he produced a further batch which were fitted with larger tanks. This brought the total numbers in the class up to 10. The first of the class has been scrapped. It is No 32107, one of the later batch. This means that only one class of the former LBSCR remains intact, the famous K class moguls.

One of the saddest things in the recent withdrawals is that the first of the three surviving Adams radial tanks has been taken out of service. The locomotive is No 30584. It seems a pity that one of these is not to be preserved.

Two more LMS 4-6-0s have gone to the scrapman. They are No 45511 *Isle of Man*, a member of the Patriot class, and No 45616 *Malta GC*, of the Jubilee class.

The L & Y railway 2-4-2Ts are also approaching extinction. The only survivor in service is No 50850. It is one of the later locomotives with Belpaire boiler. This is the last class of 2-4-2Ts left in service. One of the class No 1009 is, of course, preserved. —R.O.

Setting and machining

ANGLE PLATES

By GEOMETER

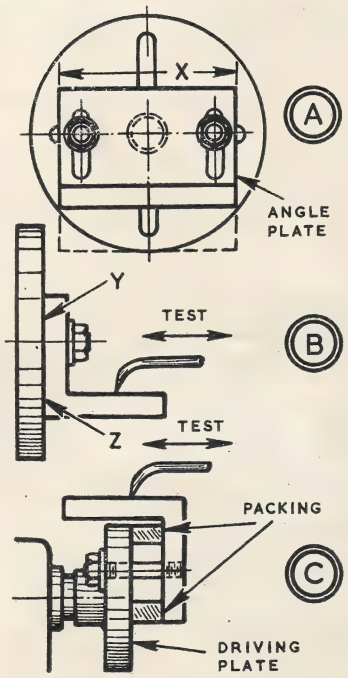
BOLTED to the faceplate of a lathe, an angle plate provides a platform on which flat-based components can be clamped. In practice, convenience in setting up (or even the ability to set up certain parts) depends on the size and type of the angle plate; while the alignment of faces and bores, which are subsequently machined, depends in turn on the accuracy of the angle plate. When set up, its face should be at right-angles to the face of the faceplate.

When components are relatively small for the lathe, there is no problem in actually mounting the angle plate. It is bolted with its flange towards the edge of the faceplate. But when components are relatively large, there is the problem of setting the platform far enough from the spindle axis. The corners of the flange may overlap the edge of the faceplate and prevent rotation; or at smaller off-sets, it may be impossible to fit two bolts for a secure hold—one, of course, being inadequate.

This problem is encountered on straight-bed toolroom lathes, and on modellers' lathes, even gap-bed ones, which are often employed for relatively outsize work. With all, the solution is the same—an angle plate bolted, as at *A*, with the flange towards the centre of the faceplate. Two bolts are easily fitted, there is the maximum length of platform, *X*, which can be a convenience for clamping components, and a smaller balance weight (not shown) can be used.

When the accessories do not include an angle plate of this type, its making can be thoroughly worthwhile—even if it is not required immediately, for the outsize job will come along sooner or later. In addition, such an angle plate offers similar advantages for setting up work on the vertical slide for milling operations.

For a casting in cast-iron, the pattern can be two pieces of flat hardwood screwed together, the screw holes plugged with putty or plastic wood. The thickness of the wood should allow for a machining cut of about 3/64 in. on each face, and possible slight warping. By showing up the pattern to the faceplate and vertical slide, the most suitable overall dimensions can be obtained.

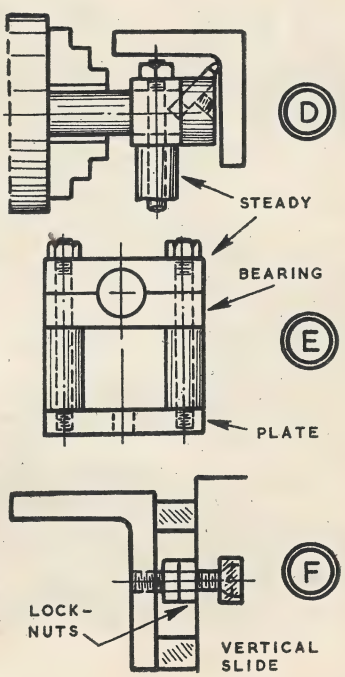


Machining of the casting is really a job for a planer or shaping machine, but it can be done on the lathe, with care. In fact, if the plate is machined on a planer or shaping machine, and is not quite accurate, it can be corrected on the lathe. This applies to most angle plates. A test of accuracy, as at *B*, is made with a surface gauge. Alternatively, a pointer can be used on the slide. If you have an indicator you should, of course, use it instead. Any error is corrected by packing with shimstock or foil at *Y* or *Z*; but to save this on every occasion the plate can be set up, as at *C*, and faced true.

The same set-up is used for an unmachined but reasonably accurate casting. First, it is smoothed by filing. Then holes are drilled and tapped for attaching it to a driving plate or chuck backplate. Packing blocks set the plate from the headstock, and shimstock corrects twists and brings the top face true. After facing, the plate is set up again for the other face.

For machining an inside face, the angle plate can be set up on the vertical slide, to use a fly-cutter or large end-mill from the chuck. In this set-up, the problem of overhang from the chuck and chatter of the cutter can be overcome by running the cutter spindle in a steady, as at *D* and *E*.

The spindle can be in mild steel, and the bearing in brass, bronze or duralumin, clamped on tubular pillars mounted on a plate bolted to the lathe bed. Shimstock washers correct small errors of height. The angle plate is mounted by drilling and countersinking a bar to take lock-nutted countersunk screws and pushing in a T-slot of the vertical slide *F*. By turning the lock-nuts, the plate can then be tightened to the slide. ▣



FOR THE SCHOOLS

Continued from 8 June, pages 706 to 708

N. F. HALLOWS concludes his four-part serial

KNURLS which show no sign of wear

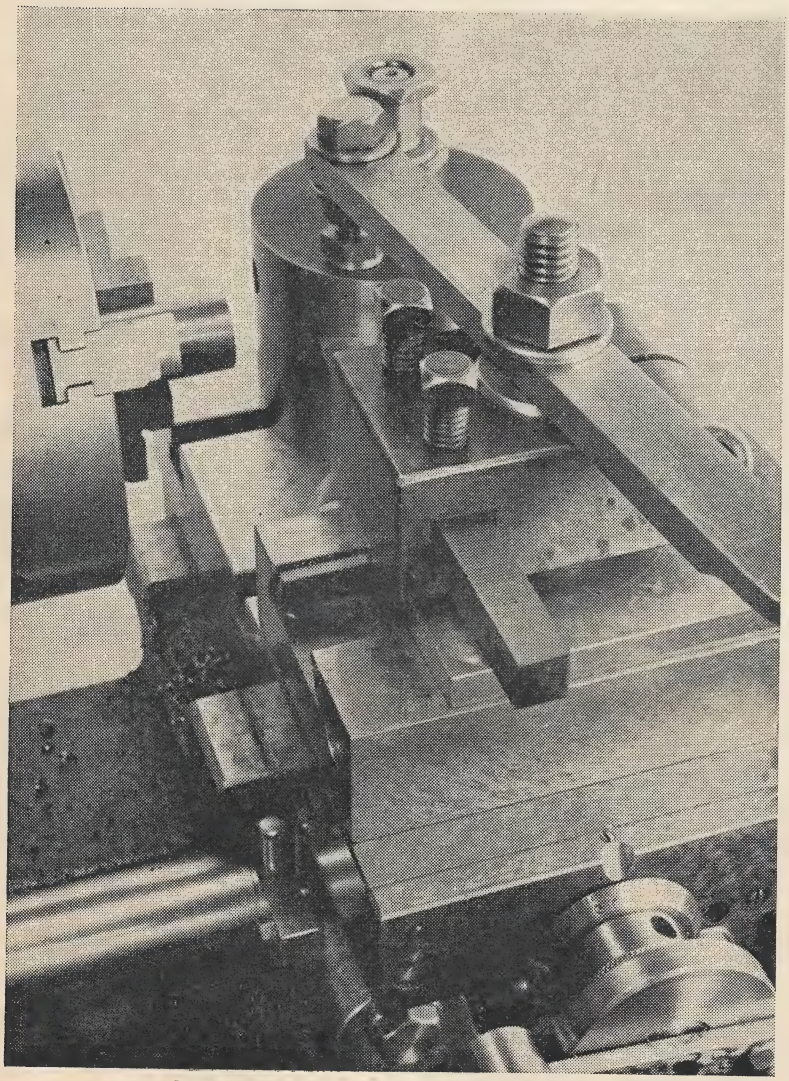


Fig. 21: Lathe set-up for planing the knurl teeth

To get true running and reduce the overhang to a minimum, I mounted the $\frac{3}{4}$ in. dia. T-slot cutter in the collet attachment fitted to the machine spindle. I set the machine to run at a medium speed, and after applying cutting oil to the work, took a cut over both blanks.

With the work indexed by the dividing head to cut 60 teeth, I took a second cut and made a check to see that the tooth so formed was brought to a sharp crest. Any necessary adjustment of the in-feed should be made at this stage before the remaining teeth are machined.

During the cutting operation the machine spindle should be locked at the set height and the cross-slide fixed by its clamping screws. If a pair of fine knurls is needed, a second and similar pair of blanks is prepared and machined with 80 teeth.

As the finish given to the knurled work depends on the surface finish of the knurl teeth, care must be taken that the milling cutter is sharp and in good condition; it must be fed evenly over the work and be well supplied with cutting oil. If you have no vertical or horizontal milling machine, you can quite well machine the knurl teeth in the lathe. The milling cutter is mounted on an arbor between the lathe centres, and the knurl blanks, as before, are fixed to an arbor which is attached to the spindle of a dividing head, mounted on the swivelling vertical slide. The attachments supplied for the Myford ML7 lathe are designed for carrying out machining operations of this kind.

An alternative method of machining the knurl teeth is by a planing operation in the lathe. It has been used successfully for making small pinions. A petrol lighter wheel machined in this way has given me unfailing service for the past 20 years.

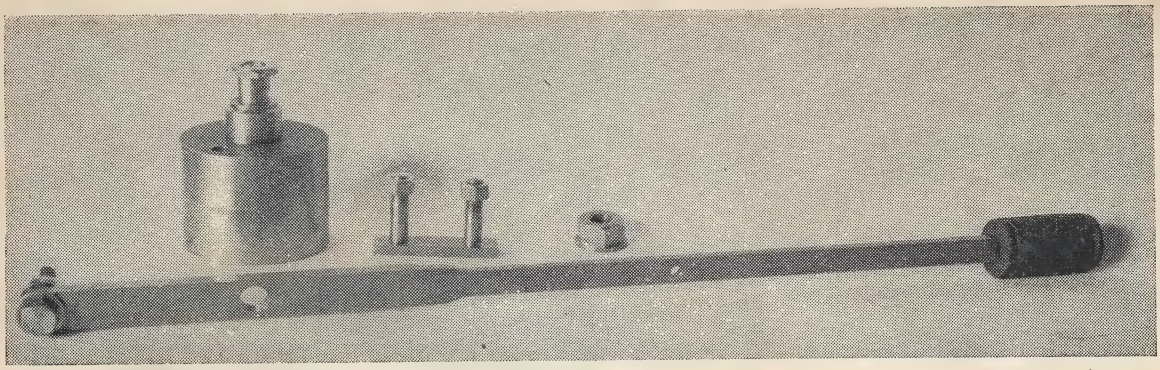


Fig. 22: These are the components of the planing attachment

To carry out the operation, the keep-plate and feed screw are removed from the lathe top slide so that it can be worked to and fro by a hand-lever, pivoted on a fulcrum-post which is secured to the cross-slide. Gripped in the self-centring chuck, the $\frac{3}{4}$ in. dia. silver-steel rod is machined and bored in the way already described. The teeth are indexed from a lathe change wheel, fixed to the tail of the mandrel and controlled by a detent attached to the headstock quadrant.

Grind the tool used for cutting the teeth to an included angle of 90 deg., mount it in the toolpost at centre and height. The complete set-up, which forms a compact, self-contained unit, is illustrated in Fig. 21.

It will be seen that using the topslide for this purpose is better than actuating the lathe saddle itself by the leadscrew or the rack gear, operations which may throw an unwarranted strain on the lathe components and cause localised wear which can affect the accuracy of the machine. You will see the components of the planing mechanism in Figs. 22 and 23.

The fulcrum-post was made in two mating parts, so that the upper could be rotated on the lower to locate the fulcrum-bolt in the correct working position. To avoid any risk of straining the table T-slot, the lower member was firmly held to the cross-slide by a long pressure pad with two studs and nuts. The long operating lever was slotted where it engaged with the stud fitted to the toolpost pillar. The knurls are not parted off from the prepared work until after the teeth have been machined for the full distance. To prevent damaging the tool point, a wide run-out should be provided.

In cutting the teeth, several light cuts are taken with the saddle securely locked, and the adjustable cross-slide stop at the rear of the saddle maintains uniform depthing of the cut. A single change wheel will serve for machining a knurl with 60 teeth, and the detent will act as a lock for the lathe mandrel.

Where 80 or 100 teeth are required, a gear train is used and the backlash is taken up by a cord attached to the chuck key when engaged in one of its slots. The cord is led over the edge of the bench and a weight is attached to its lower end. These gear trains will be found suitable:

Mandrel wheel	Stud wheels	Divisions
40 ←——→	25	
	50 ←— Detent	80
50 ←——→	20	
	40 ←— Detent	100

After the two knurls have been parted off, they are mounted on a stub-mandrel for chamfering and facing the sides to reduce the parts to the exact finished thickness. Instead of gripping the knurls in the chuck, clamp them between two strips of wood in the machine vice for finishing the bores with a 90 deg. countersink in the drilling machine. In this way possible damage to the crests of the knurl teeth is prevented.

For the hardening process, the two parts were attached separately to a length of nickel-chrome wire of the kind used in electrical heater elements, and the heat was supplied by a gas blowpipe with the air fed from a rotary-vane compressor. The parts were placed on a fire-brick in the brazing hearth, and protected from the direct heat of the flame by asbestos chips to prevent overheating and burning of the knurl teeth. As soon as bright red heat was reached, they were lifted by the wire and plunged into water.

At this point you should test the components with a file to make sure that they are properly hardened. If

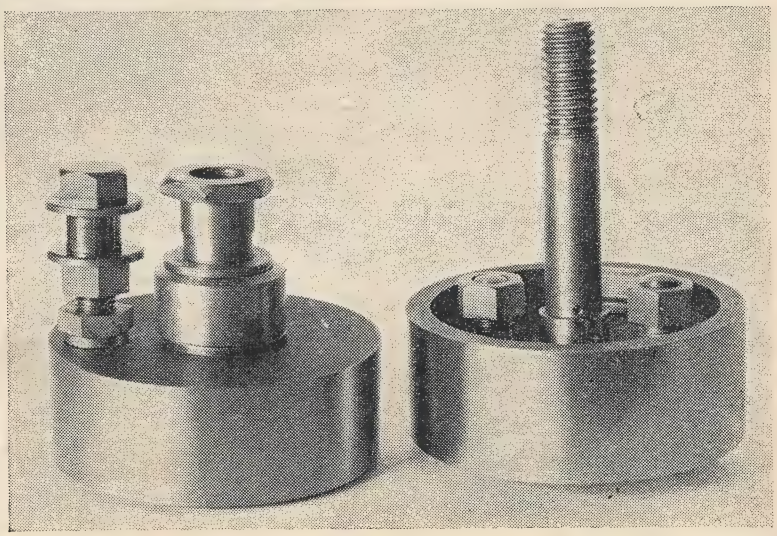


Fig. 23: Constructional details of the cross-slide fulcrum-post

the correct degree of hardness has not been obtained, the parts must first be annealed, by reheating and cooling slowly, before rehardening.

In the fully-hardened state the knurls, if put to work, would crumble. Tempering is therefore necessary to reduce the hardness, while the steel is left tough enough to withstand the crushing pressure to which the knurls are subjected.

If the work were exposed to the direct heat of the flame, the exact degree of heat would be difficult to control and there would then be a danger of softening the fine knurl teeth. Uniform heating to the correct temperature was obtained by use of the sand bath in Fig. 24. It consists of a small biscuit tin, held in a retort stand and filled with fine dry sand to a depth of about 2 in. The sand was gradually heated by a Bunsen burner and was stirred continuously with a strip of bright mild steel.

As soon as the steel stirrer had assumed a deep-straw tint, the burner was withdrawn and each knurl, attached to a wire, was embedded in the sand and inspected at frequent intervals, until it was found that the former straw tint had been obtained. At this stage the knurls were finally quenched in water. All danger of overheating the work had been avoided and uniform heat treatment had been achieved.

This method of tempering can also be used with advantage for treating circular cutters and other small tools made in the workshop. After the hardening and tempering operations, you may find it necessary to relap the knurl bores to get free running on the pivot screws. If the hardened knurls have not sufficient working clearance in the forked arms, they can be accurately fitted by careful rubbing down on a carborundum or India stone. ▣

O *Earlier instalments: May* 11, *page* 581; *May* 25, *page* 642; *June* 8, *page* 706.

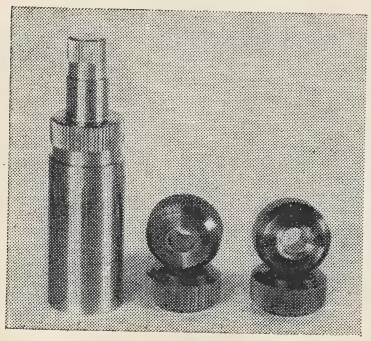


Fig. 25: *Test-piece machined with the two pairs of straight-tooth knurls*

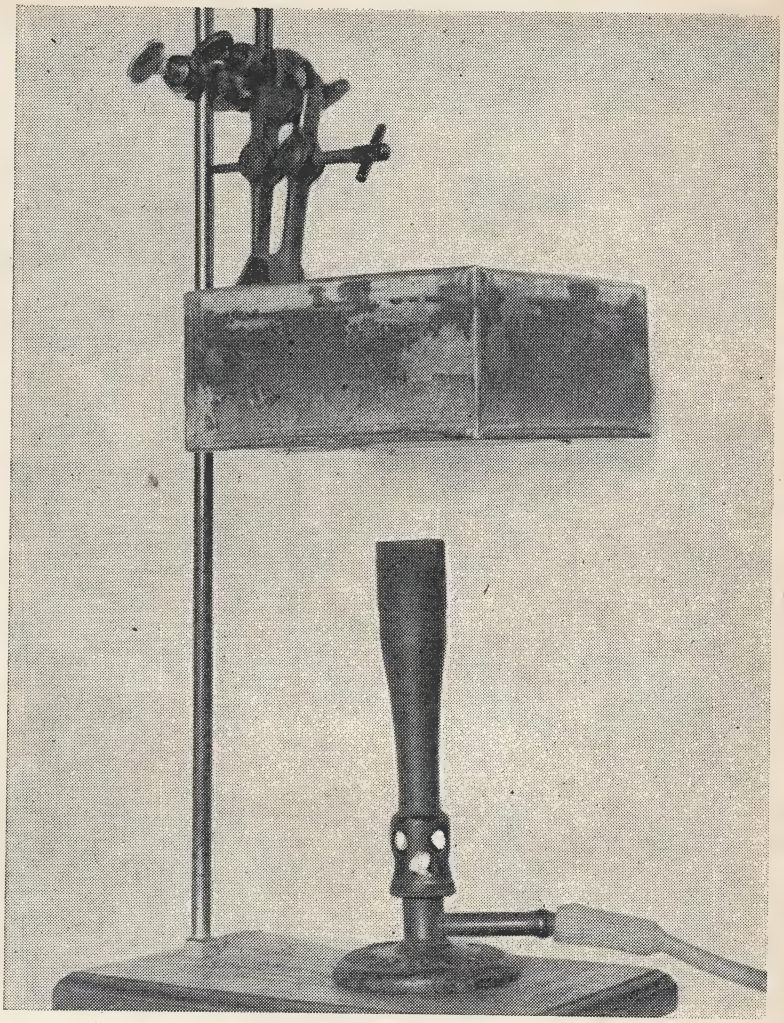


Fig. 24: *Sand bath for tempering the knurls*

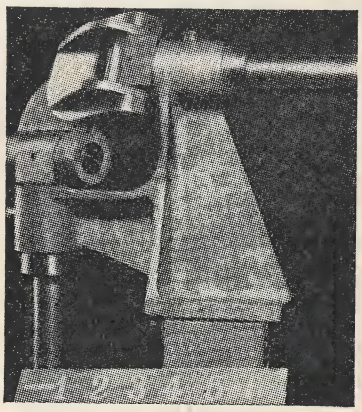
ANGULAR TRANSMISSION COUPLING

A NEW form of universal coupling for the angular transmission of motion consists of a steel tongue fitting in a bronze fork, these components being pivoted on the respective shafts to be coupled.

The tongue and fork are accurately machined to provide minimum backlash and virtually silent operation, and the pivots are designed for long wear without lubrication by the incorporation of PTFE impregnated brushes and thrust washers.

In the form illustrated, the coupling is a 90 deg. one, but the system is equally effective at any angle from 0 to 110 deg., and can be used to couple parallel offset shafts. In all these applications a uniform angular velocity ratio 1 : 1 is maintained; the torque and speed variation which arise with normal types of universal couplings do not apply.

Based on "Engineering Materials and Design," July 1960. Manufactured by Peckett and Sons Ltd, Atlas Works, St George, Bristol 5.



REEDS are reliable

says RAYMOND F. STOCK in the third instalment of his serial for the uninitiated. He also explains the advantages of using electronic filters

FIG. 4 shows the schematic arrangement, lettered as for Fig. 3, but *C* is now a reed bank. The audio oscillator *D* is arranged to be a type of circuit in which the frequency is set, at least partly, by a resistor: several such resistors of different value are provided (two are shown) and any one may be selected by closing the appropriate contacts. With the contacts open no audio tone is produced.

In principle and construction the reed unit is similar to an ordinary headphone, if one imagines the diaphragm replaced by a set of spring steel reeds, one for each channel required. A reed of this type has a resonant frequency (the natural frequency at which it oscillates when plucked) set by its thickness, length and modulus of elasticity. When audio frequency energy is present in the energising coil, the reed will vibrate if the frequency is correct, and is thus able to discriminate against unwanted tones.

The surface of the reed is plated, and in vibrating it makes intermittent contact with an adjacent wire. It thus closes a circuit which is arranged to supply power to a local relay. Consequently the two-channel system in Fig. 4 would have a two-reed bank followed by two local relays, either of which could be operated by closing one or other of the two contact pairs keying the transmitter.

In practice, reed units have a minimum of three channels, and the range usually includes four, six, eight, ten and twelve channel gear. The reed bank itself does not grow proportionately to the number of channels and the radio remains the same, except for the keying resistors. There is thus some considerable inducement to employ more channels at the expense, virtually, of multiplication only in the final relays.

A steel reed is equivalent to a sharply tuned circuit—it responds to its own correct frequency and only a very narrow band of frequencies either side of it, beyond which its response falls off rapidly. It is, therefore, possible to discriminate between a dozen tones all set within one octave (the highest will be less than $\times 2$ the lowest frequency). The use of a single octave is important; a reed will respond to a note one octave above its resonant frequency (though not to the full extent). For this reason it is desirable to choose a range of tones which does not spread over an octave or more.

Any resonant filter, mechanical or electrical, (and a reed is only one type of mechanical filter) needs the application of many cycles of the applied audio tone before it reaches its full amplitude of oscillation and operates its channel relay. The sharper its resonance curve—the better it is at discriminating between tones—the more cycles of audio energy must be applied, and so there is a delay between keying the channel and operation of the channel relay.

It is desirable to keep the resonance curve sharp to prevent any reed from responding to an adjacent channel frequency. The only way that the delay could be reduced would be by raising the audio note. This would in turn require a shorter reed with proportionately less amplitude of vibration at its tip, and difficulties would be introduced in the contact arrangements.

Reeds employ frequencies of about 300-500 cps.—mainly in the octave above middle C on the piano—and with practical techniques of manufacture the values cannot be raised. In practice, therefore, some delay is inevitable and reed systems cannot be used above a few pulses a second. This limits the type of control system which can be operated.

A reed is set for frequency by cutting to length in manufacture, and the audio tones are invariably adjusted to suit the reed rather than the other way about. This explains the variable resistors shown in the keying circuits of Fig. 4. In most transmitters these resistors are in fact potentiometers and are fitted in an accessible position as pre-set controls. When new, and occasionally throughout the life of the equipment, the potentiometers must be adjusted to give maximum response at their corresponding reeds.

Reed units suffer from the same disadvantages as sensitive relays; they tend to be vulnerable to vibration, accidental damage, maladjustment and weather. This is inevitable as each reed has its own relay, while the reeds themselves offer possibilities for contact troubles. But much development over the years has ironed out the major snags, and present-day equipment is very reliable, though it must be treated with discretion and protected from water, oil and fuel.

To sum up, reed equipment (valve or transistor operated) is a little more delicate, because a little more complex, than single channel gear, but it offers great flexibility without commensurate expense in number of

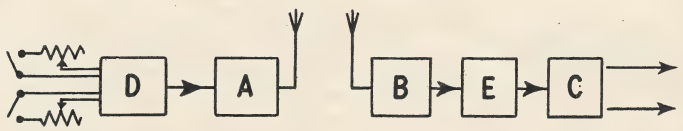


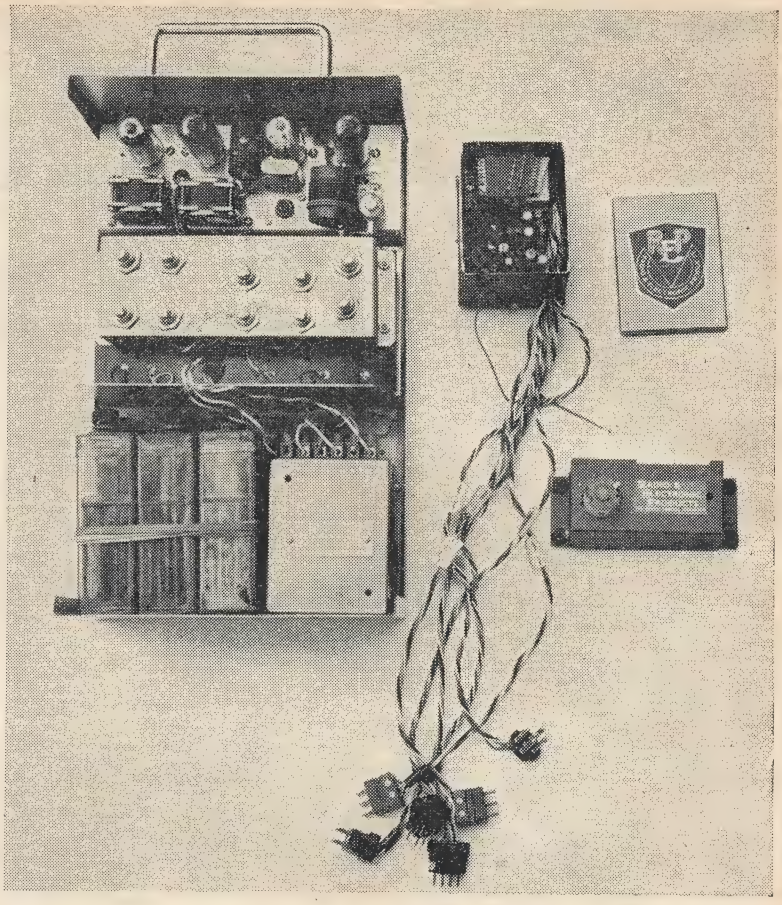
Fig. 4: *General arrangement of reed system with two channels*

channels, though without being able to provide high speed keying on any one of them..

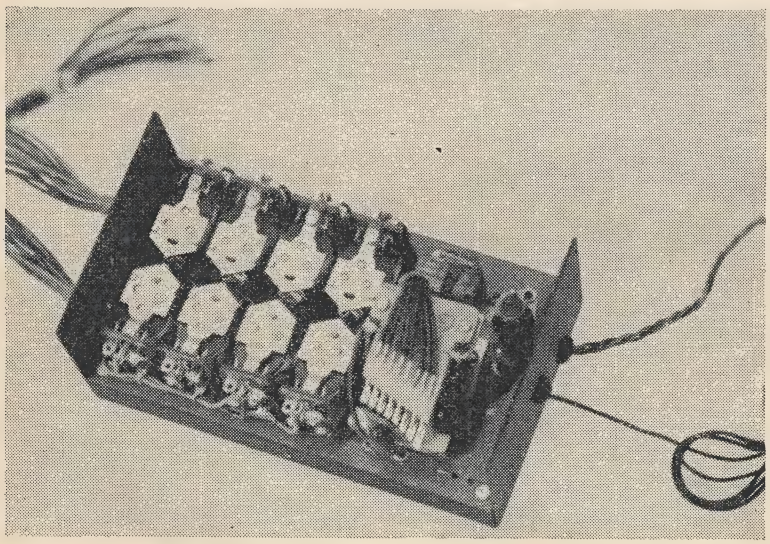
Simultaneous operation—not really a separate class of equipment, but rather an extension of the equipment which I have described—permits the operation of more than one channel at once.

The audio oscillator in the transmitter can operate at only one frequency at a time. If two separate oscillators, each tuned to its own frequency, are provided, they can be keyed independently and, when it is necessary, simultaneously. The block schematic diagram is then as shown in Fig. 5, which is lettered as before, D_1 and D_2 being the separate oscillators. The rest of the system is the same as before.

But there is more to it than multiplying the audio oscillators. In a single channel tone system or non-simultaneous reed system, the carrier wave is modulated with only one audio frequency at a time. The audio modulation can thus be 100 per cent —in other words, the 27 Mcs. carrier can be modulated from its full amplitude down to zero, so that all the available power can be used to convey the modulation. When two frequencies must be used together, they must, not unnaturally, share this 100 per cent, and get 50 per cent of the modulation depth each. This means that with the same receiver the power of each note at the reed unit is only half what it would be if it were used alone. There may be enough



REP ten-channel equipment. Lead acid cells power the transmitter. HT comes from the converter to their right. The potentiometers on the centre panel allow the audio frequencies to be adjusted. Carrier frequency is controlled by a crystal (left of the tuning coil). The transistorised receiver has no relays



ED Black Arrow 8. *Nearly all the small radio components are below the chassis, the reed unit and the eight terminal relays occupying most of the space*

to operate the reeds, or it may be easily possible to provide a little extra amplification to compensate. But if we required twelve simultaneous channels, we should have a very different proposition, calling for much more amplification in the receiver, as well as for twelve valves and sets of oscillator components in the transmitter.

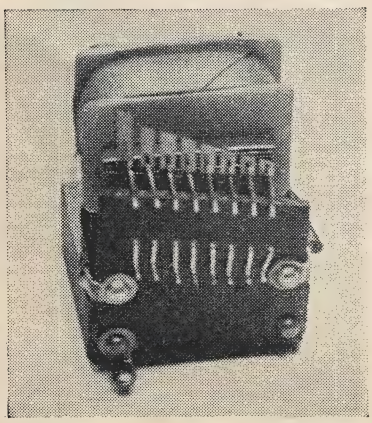
There is another difficulty. In transmitting only one tone, the fidelity of the system is relatively unimportant and circuitry is simplified. As the numbers of simultaneous tones are increased, we require better and better standards of amplification, or distortion can easily arise. Distortion

may prevent the reeds from responding faithfully to their own tones, or encourage them to vibrate at some artificial tone—actually a product of distortion—when their correct channels are not being keyed.

Altogether, life gets tedious for everyone, and fully simultaneous channels are rarely seen. There is one saving grace—the noble art of compromise. In practice we should hardly need all channels simultaneously, as the functions of some will almost certainly be mutually exclusive. The usual result is, therefore, to offer a system with, say, two audio oscillators each capable of handling three non-simultaneous tones, or three oscillators each with four tones.

Owing to the increased number of stages, and possibly to the more refined circuitry, such systems tend to be dearer. But they may be worth while if it is necessary to control, say, steering and speed simultaneously.

Reed receivers may be transistorised or may employ valves; the end result is the same, and the only effect on the reed unit is to control its resistance. As with relays, high values of several thousand ohms are used with valves, while low resistance reed units of several hundred ohms or less are indicated for transistors.



REP eight-reed unit

The weakest link in any reed system is likely to be the intermittent contact made by the tip of each reed, and there is a tendency today to reduce the current and voltage across these delicate contacts by using them to trigger a transistor, which amplifies the weak signal and operates the channel relay with more power in hand. There is also no basic reason why the channel relay should not be completely replaced by a power transistor directly energising servo motors, actuators, and so forth, though once again the output would be on-off rather than s.p.c.o. Transistors are not used as yet in the output of commercial reed equipment.

Multi-channel working has been a common aim since the early days of radio control, and no better solution has yet been proposed than the use of several modulating audio frequencies to distinguish the required channels.

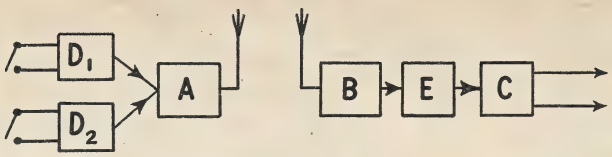


Fig. 5: Simultaneous reed system

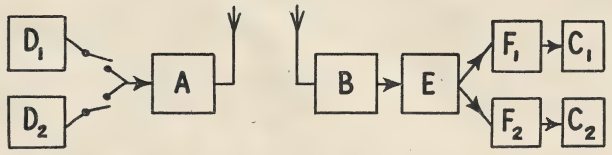
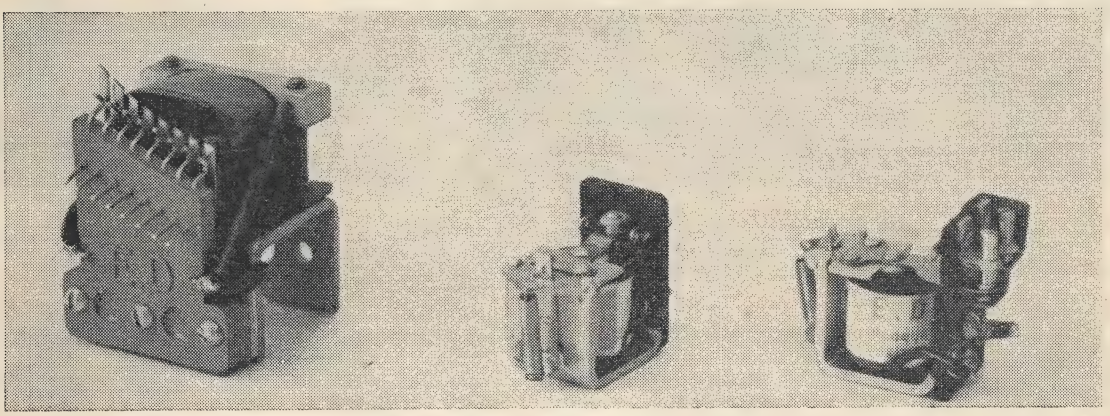


Fig. 6: Electronic filter system: two channels



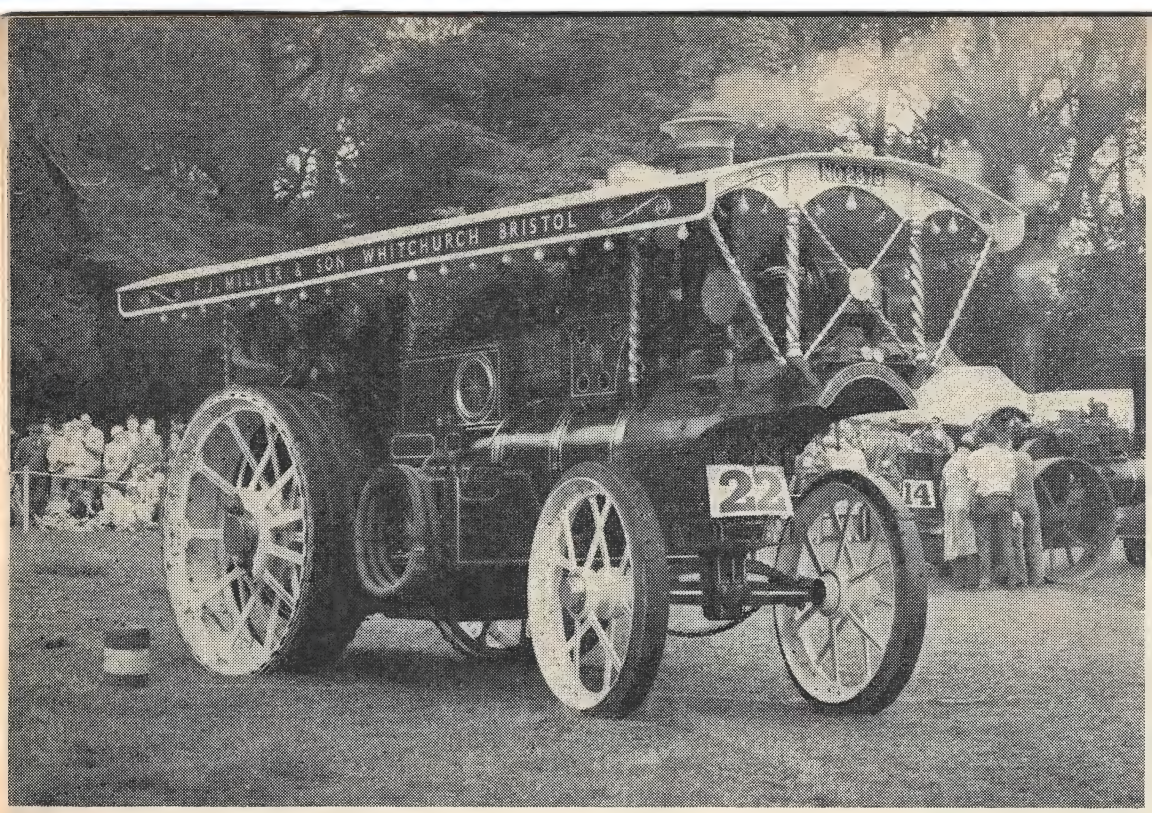
ED eight-reed unit and two small sensitive relays

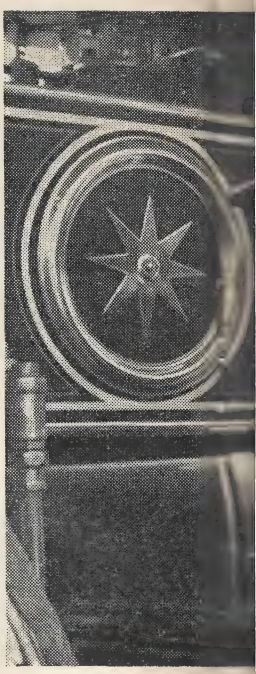
Reeds were the earliest and are still the commonest means of interpreting the audio tones; but a better, though usually more expensive, method is the employment of electronic filters.

Fig. 6 shows the block schematic diagram, where D_1 and D_2 are audio oscillators, keyed by break contacts in their output. Either D_1 and D_2, or both of them, can modulate the r.f. oscillator A. Signals are picked up by detector B, amplified by audio amplifier E and fed to filter units F_1 and F_2. These operate relays C_1 and C_2 each of which offers the usual s.p.c.o. facility.

It will be seen that the diagram is drawn as a simultaneous system, and that the greater refinement of filter

● *Continued on page 779*





George W. Eves writes of a typical rally—it might be anywhere in England—and these pictures by Barry J. Finch illustrate some of the engines which thousands see as the Anglo-American cult of the traction engine continues to prosper. Here is a dignified Burrell—No 2379, F. J. Miller and Son, Bristol.

OLD G

For the countryman the year is made up of agricultural shows, cricket weeks, garden fetes, ploughing matches, sheep-dog trials, point-to-point meetings, clay pigeon shoots and beagling. To these we must now add the traction engine rally.

Until a few years ago grey-beards and gaffers would gather round a couple of old engines at some remote farm. Today old engines attract thousands of both sexes and all ages.

My first rally this year was on a farm high in the hills. On the slopes behind the roped-off enclosure, lines upon lines of cars were neatly shepherded. I could see in the far corner of the field tall black chimneys, drifting smoke, and white feathers of steam. Here was the magic which, forgotten after the First World War, had returned to the countryman's year. Grabbing camera and sunglasses, I locked my old car and mingled with the eager crowd.

When some traction engines were put up for sale in Kent two years ago, the auctioneer referred to them as Old Gentlemen. With farm buildings and green beechwoods forming a natural backdrop, 25 of these Old Gentlemen stood in gleaming array. There were small ones and giants. There were traction engines which had once hauled three ten-ton trucks of bricks, and threshing engines which, as their names imply, had gone from farm to farm to extract the grain from the sheaves. There were rollers which made up flint roads before all the roads were macadamised, and ploughing engines which turned the furrows before tractors ousted them. The kings of them all were the showman's engines used by amusement caterers to transport the fun of the fair from town to town. With the passing of the steam era, they still retained every bit of their former glory.

Great credit is owing to the few stalwarts who foresaw the day when these descendants of Richard Trevithick's first locomotive would be lost forever to the breaker's sledge hammers and welding torches. Since then, men in all walks of life have bought up these rusting giants as they ended their days in farm sheds and open fields. Hard work and money were the only tools, but how they have triumphed !

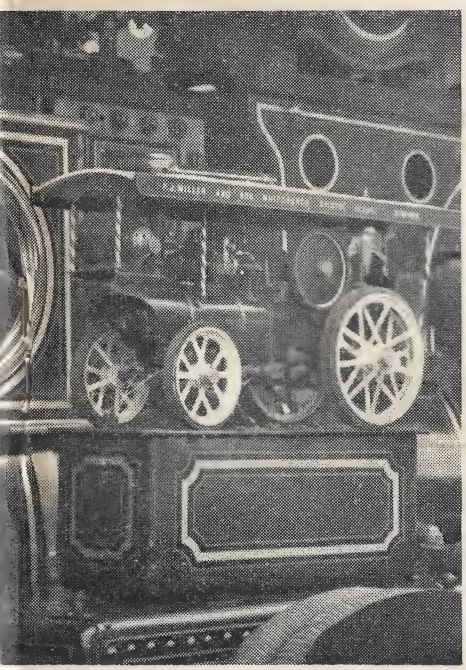
I had difficulty in finding a gap to poke my lens through. Tape recorders captured an echo of yesterday as the engines quietly ticked.

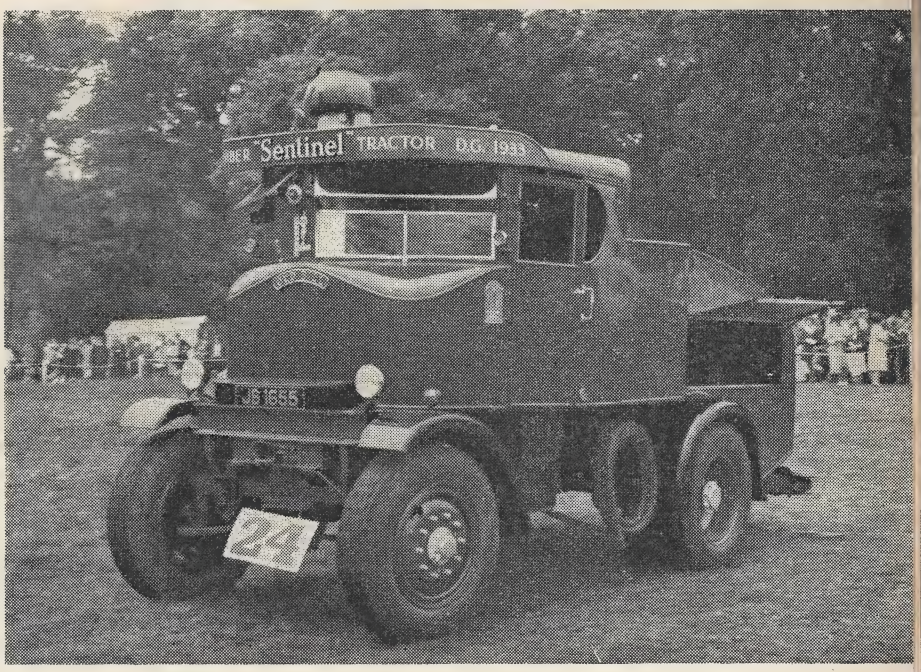
Two perfect examples of the showman's engine towered above all others. Painstakingly restored, they wore the brilliant colours favoured by fair-ground dwellers; twisted brass rods supported a canopy glowing with coloured lights.

Whereas the internal combustion engine soon makes its presence obnoxious, here we had the pleasant smell of warm oil, and a gentle hissing, which revealed the source of a hundred and more horsepower.

We moved from engine to engine. Those of us with thinning hair relived happy boyhood days that later generations will never know. Parents explained the engines to children brought up on Wells Fargo and pop singers. Women in gay summer frocks added colour to the scene.

Over by the barn a Fowler—a name that steam men utter with all the reverence accorded to Rolls-Royce—was driving a threshing machine and a





Left: Full-size and model ("F. J. Miller and Son, Whitchurch, Bristol, Scenic Engines"). Right: This Sentinel tractor (DG 1933) belongs to J. Hutchens. Below: Foden steam tractor No. 14078, owned by G. Howell, was built in 1932

GENTLEMEN take the sun

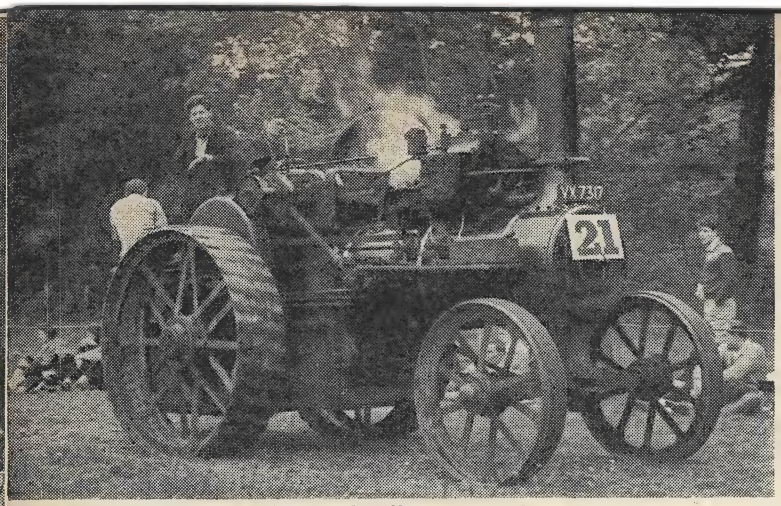
By GEORGE W. EVES

straw baler, a combination which the combine harvester has completely replaced. Youngsters will never know the fun of threshing days, ending when rats and mice bolted in all directions.

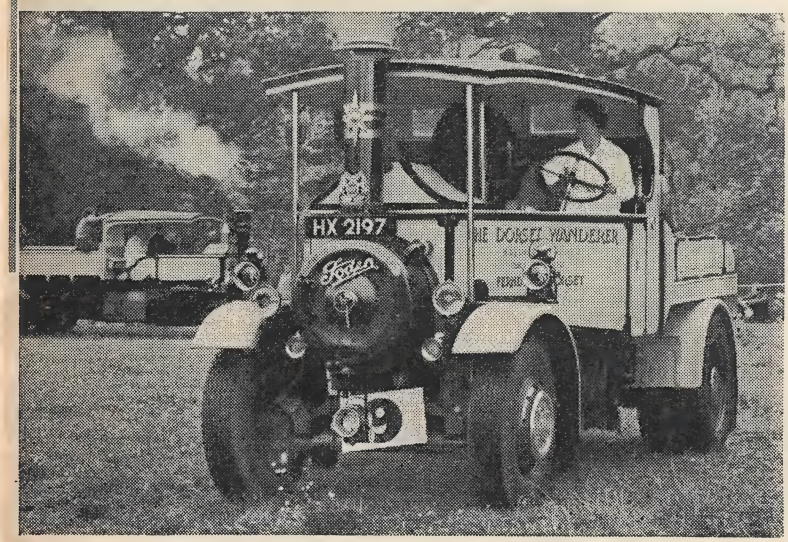
Marshals formed the engines up in correct order, and loud-hailers called the crowd to the arena side as No 1 chuffed proudly on to the sun-lit stage. A well-informed commentator gave a short history of each engine as it passed his box: the Foden steam wagon, such as was used to deliver refreshing waters to the hostelries in my Kentish village; the threshing engine, like those which passed our house; the roller that always came in the autumn; and the Fowler compound ploughing engine that delighted my school days.

The *pièce-de-resistance* was, of course, the showmen's engines, but my day was made when along came a tiny Tasker engine which my father had told me about at Loampit Hill. A steam fire engine drawn by a couple of grey horses brought up the rear, and as it lumbered out of the arena there was borne on the air a newer and more familiar sound. The parade of the veteran cars had begun. Into our view came the weird vehicles for which the landed gentry abandoned their carriages, wagonettes and dog carts. But whereas the Old Gentlemen passed before us with dignity, these spindly old cars to me were Chaplinesque; two of them needed only the Keystone Cops.

After that, the crowd settled down for the main events. The steam fire engine demonstrated that it could still throw a couple of useful jets, but the obstacle races and musical chairs were hardly in keeping. Steam engines were not intended for that sort of thing. They came of sterner times. Apparently sharing my views, many in the crowd



Ransome, Sims and Jefferies owned by D. Martino



Foden No 13832 *was turned out* 30 *years ago as a wagon for Fuller, Smith and Turner, London brewers. It delivered beer to the thirsty citizens of Chiswick throughout the war. W. D. J. Sparrow of Dorset is the owner, with Miss Sparrow as mate*

Another Foden No 11538 *was new in* 1924, *when it went to Hector Buchanan, in the Isle of Ely. Last year it was bought by J. H. Fisher of Reading, Berkshire*

turned to their picnic baskets and the queues for ice-cream.

I left my Old Gentlemen gyrating round the oil drums in the arena. The last things I noticed were the huge diesel transporters which had brought the defeated steam era from afar.

Thank you, Old Gentlemen. ▣

The pictures by Barry J. Finch were taken at the recent Beaulieu rally.

Wallis and Steevens: EILEEN (*top*) *and* BOXER'S BEAUTY

MYA OPEN RC AT RICK POND

SAILING of model yachts under radio control is becoming more and more recognised in official circles. The yachts being measured and classified at present as the "Q" class. It consists mainly of former A class boats, and adjustments are made to sail area, and so forth, to allow for the additional weight of the radio gear and batteries. As radio control for yachts is developed, provision will no doubt be made for the smaller boats, as several examples exist of 10-raters and M class boats which use radio control very successfully.

The MYA Open Championship for the Q class was sailed off at the Rick Pond, Surbiton. On the Saturday the weather was showery with strong winds. The Sunday was bright with no rain, although the wind was still gusty, with one or two gusts of 35 m.p.h., almost force 8 on the Beaufort Scale. They brought the lee rail under on many occasions, but there seemed to be no trouble with water getting at the radio gear, as often happened in the past.

With the gusty winds it was difficult at times to hold the boat on to her course, and there were more disqualifications than usual through boats hitting buoys than usual. Two competitors who looked like topping the list—Gascoigne and Stalkartt—both failed to top it from this cause. B. R. Winter had trouble with his radio gear and did not sail at all on the Sunday.

The results for Saturday were not recorded. Those listed are for Sunday.

EDWARD BOWNESS

Place	Skipper	Town	Boat	Score
1	T. G. Carrington Wood	London	*Vanessa*	13
2	J. Gascoigne	Twickenham	*Senorita*	12
3	A. T. Tamplin	Chichester	*Selma*	8
4	G. J. F. Stalkartt	Gosport	*Mimosa*	7
5	J. Merrick	Birmingham	*Gypsy*	4
6	J. C. Hogg	Southampton	*Sunlight*	2
7	B. R. Winter	Twickenham	*Zephyr*	0

FIFTY YEARS . . . *Continued from page 765*

passenger and freight duties in the Western Region of British Railways. Engines and transmission are of German design similar to those installed in the Warship class, but are manufactured in Britain under license. The engines are the British Siddeley Maybach MD870 and the transmission Stone-Maybach Mekydro K184U. This unit is one of the smarter designs.

The last two exhibits on line were both steam locomotives listed for preservation. Next to the Beyer Peacock stood the Class 8P 4-6-2 *Duke of Gloucester* 71000, the only locomotive of its class and one of the most powerful of British Railways, standard steam engines. It is often mentioned in arguments against the policy of changing from steam to diesel. Whatever claims are made, there can be no doubt that 71000 is a first class example of British engineering. It is pleasant to know that when she retires from the iron road she will not come under the breaker's hammer.

Her companion wore a small plate on her deflector plates informing us that she was the last steam locomotive to be built for British Railways, class 9F 2-10-0 *Evening Star* No 92220. Do you know that *Evening Star* is the 999th steam locomotive in the whole of the British Railways standard range?

I think it will be agreed that the show was impressive and interesting. If I had to make a criticism, I should point to the lack of publicity. Here was a wonderful opportunity of showing the public what our engineers were producing to create a railway second to none.

The past 50 years have seen the steam locomotive developed to a stage where we cannot see how it can be made more efficient. The Institution of Locomotive Engineer is justly proud of its members who have played a large part in this development, and on the proud occasion of its Golden Jubilee must be optimistic for the future with a new era of traction already opening. For while we may feel sentimental at the passing of the steam locomotive, there is not the slightest doubt that tremendous scope on new skills and techniques awaits the young engineers of today. With the future promising to be just as exciting as the past, what more could anyone wish at a Golden Jubilee? Congratulations to The Institution of Locomotive Engineers. ▣

RADIO CONTROL

Continued from page 775

circuits makes simultaneous working appropriate and usual. This need not, however, be so.

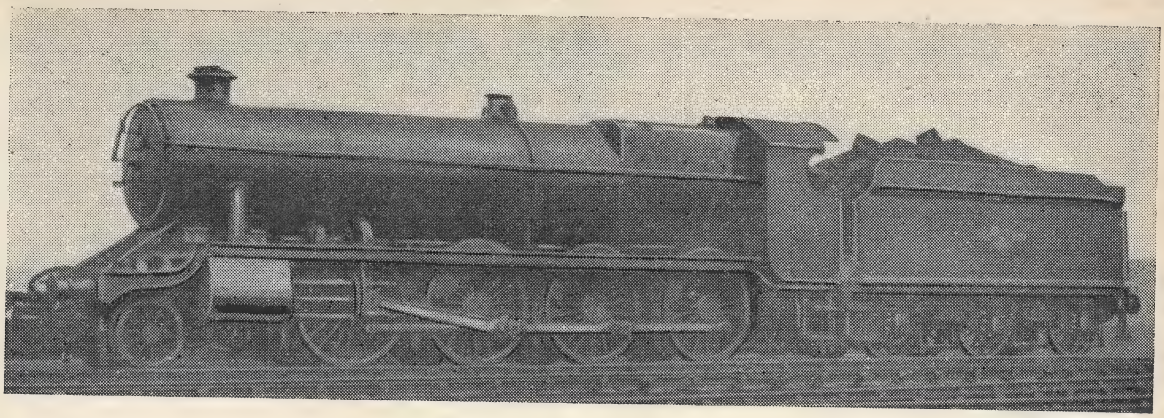
The same considerations of time-lag in a sharply resonant filter circuit apply here as with reeds; but whereas the upper limit of frequency was fixed before by reed dimensions, there is no such limit for filters, and audio tones of several thousand cycles are commonly used. They enable the inherent delay to be much reduced and permit the use of high speed pulsing on each channel.

Another advantage is that resonant electronic filters contain no moving parts and are, therefore, as free from troubles as other electronic equipment. The output of each filter channel can operate an only-moderately-sensitive relay, so that contact troubles are much reduced. Alternatively (and this arrangement probably represents the ultimate in present-day practice) they may terminate in a power transistor so that the complete radio system is all-electronic throughout.

There is, of course, a price to pay. More refined and complex circuits are needed to generate and amplify the signals, while two valves (or two or three transistors) are usually necessary in each filter circuit. This makes for complexity, though not necessarily, with transistors, for bulk, weight or increased power supplies.

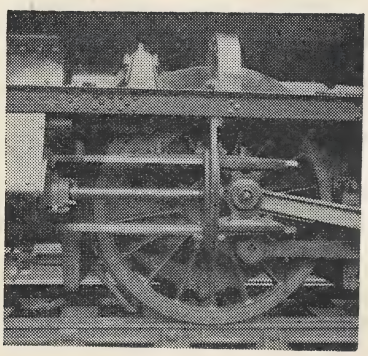
The types of circuit used today for audio oscillators and filters are very stable. Once set, they need no further adjustment, and therefore no frequency control is shown in the schematic diagram. It is usual to design this class of oscillator to run continuously, so that keying is carried out by interrupting the oscillator output line as shown (or earthing it). In practice, the oscillators may not have adequate power to modulate the r.f. stage and an intermediary amplifier or modulator valve is then employed.

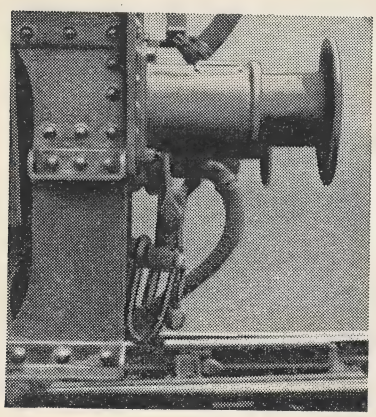
★ *To be continued on July 6*



LIBRARY OF LOCOMOTIVES

By ROBIN ORCHARD





THEIR THIRD FAVOURITE —the 4700 Class

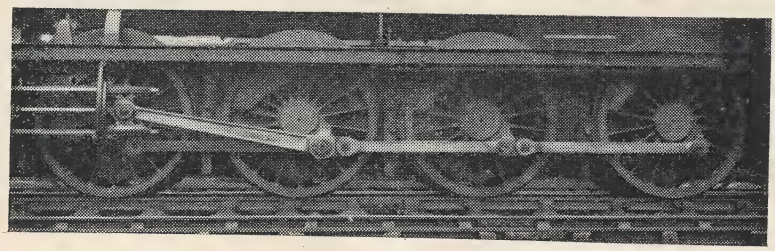
Continued from 8 June, pages 709 and 710

In the 4700 Class the firebox has a grate area of 30.28 sq. ft. The tubes provide a heating surface of 2,062.35 sq. ft, and the firebox adds 169.75 ft, making a total evaporative heating surface of 2,232.1. As the superheater provides 289.6 sq. ft of heating surface, the total heating surface of the locomotive is 2,521.7 sq. ft.

There is room in the tender for 4,000 gallons of water and six tons of coal. The six wheels are 4 ft 1½ in. diameter.

In all, the engine weighs 82 tons, made up of 8 tons 12 cwt on the pony truck, 17 tons 5 cwt on the leading coupled wheels, 17 tons 2 cwt on the driving wheels, 19 tons 9 cwt on the third set of coupled wheels, and 19 tons 12 cwt on the rear coupled wheels.

The tender has a weight of 46 tons 14 cwt—15 tons 12 cwt on the leading wheels and 15 tons 11 cwt on the other two pairs. Together, engine and tender weigh 128 tons 14 cwt.



Overall length is 66 ft 4¼ in., overall width 8 ft 1 in., and overall height 13 ft 4⅜ in. The tractive effort at 85 per cent boiler pressure is 30,460 lb.

When Brian Western and I visited Old Oak Common to photograph No 4700, we asked some of the drivers what their six favourite Western steam locomotives were today. They all agreed that the Kings and Castles were the best, particularly now that all the Kings and many of the Castles had double chimneys.

Their third favourite gave us a surprise as it was the 4700 class. They said that it was a locomotive which could haul anything, ran very well, and was rarely overloaded. The next three places were filled by the Hall and County class 4-6-0s and the BR 9F 2-10-0s.

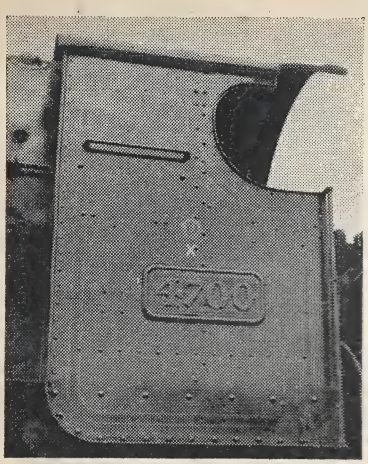
This is, of course, only the view of a few drivers; no doubt others have a different opinion. But it showed how popular the 4700 class is with the crews. Indeed, I heard only one complaint—the rather sparse comfort and shelter which the cab provides.

At one time the 4700 engines were to be seen on passenger trains occasionally, but today they run almost exclusively on freight duties. Two such duties are the 8.30 p.m. Old Oak Common to Tavistock freight, which runs from Mondays to Fridays, and the Saturday evening old Oak Common to Shrewsbury freight, a Hall duty during the week

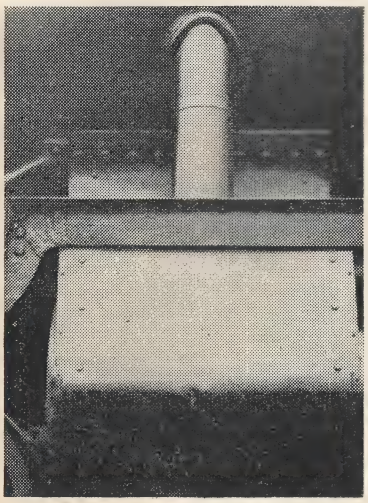
Continued on page 791

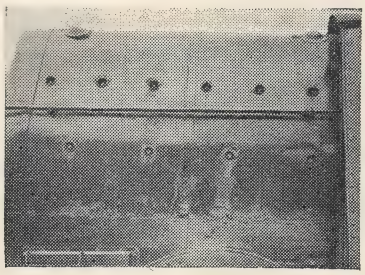
AN ME
STAFF
FEATURE

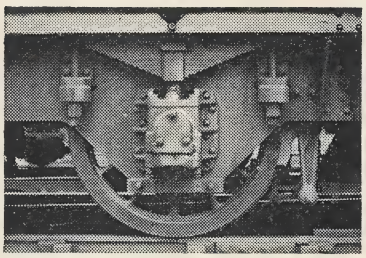
Pictures by
BRIAN WESTERN

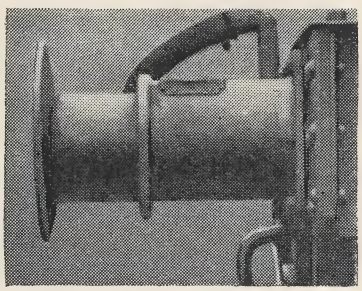


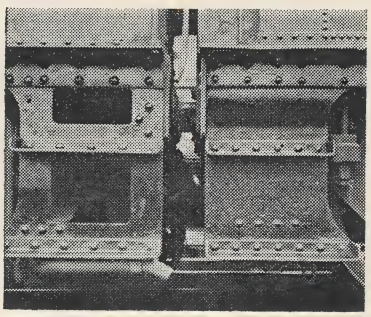
White X *denotes that the locomotive is unable to take loads above those specified by the working timetable*

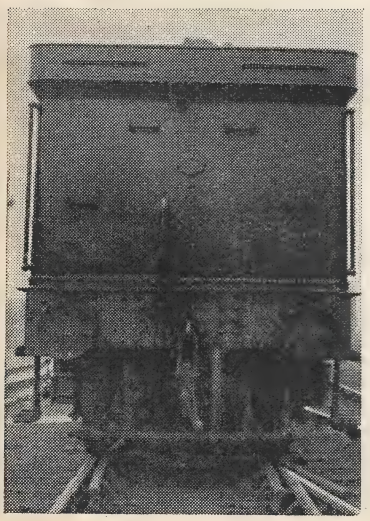


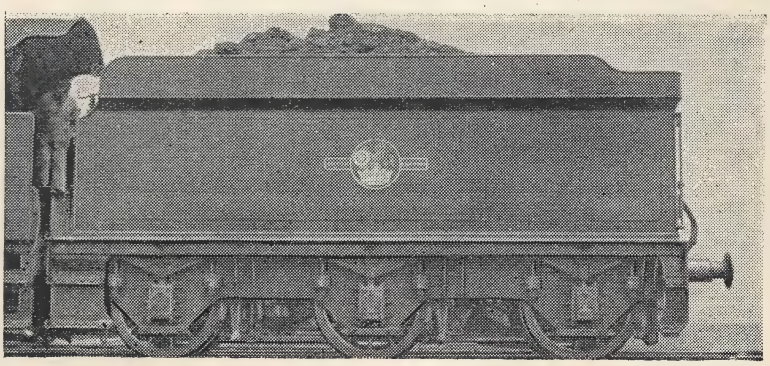












Eric Rowland pulls back the traverser with a SPEEDY *aboard. The turn-wheel which raises the span is just in front of his right foot. Behind him is W. A. Carter of SMEE. Victor Storey of SMEE sits on the steaming bay*

Live-steamers' delight

IF Isambard Kingdom Brunel could take an astral look at the Sussex Miniature Locomotive Society's track I am sure that he would heartily approve.

For at Beech Hurst, a public park on the outskirts of Haywards Heath, the Sussex MLS have laid down a 1,150 ft track that emboides at least three principles to which Brunel gave great thought—reasonable gradients, easy curves and immaculate train control.

To the ease of driving are added the pleasant surroundings of a well-groomed park and scenic views across the Ouse valley to the rolling South Downs, dominated by Ditchling Beacon sign-posting the road to Brighton.

LESLIE B. HOWARD spends a Saturday afternoon at Beech Hurst in Sussex

This must surely be one of the most attractive of our club tracks. What is more, it is one of the most up-to-date.

The track, which offers facilities for 3½ in and 5 in. gauge locomotives, is continuous. Beech Hurst, the one station, is at the bottom end of the straight and is conveniently situated where most visitors get their first glimpse of the line.

A curve, almost a hairpin, brings the track alongside a bank of rhododendrons; then in an S-curve, it sweeps under a rustic bridge which gives access to the bowling greens that the line encloses.

Beyond the bridge it swings away on a moderate bend through a deep cutting. Then the radius eases for a fast curve past the engine shed and traverser, and the line runs on into the long straight leading to Beech Hurst platforms. Gradient and milage posts aid the driver all the way.

So much for the delights of the eye; now for the facts which appeal to the technical mind.

Sussex MLS track is an excellently engineered piece of work. It is obvious that a great deal of thought went into its conception.

The men of Sussex who laid it were at great pains to match the gradients and curves to the pleasant parkland in which it is set, and to provide excellent scenic views for the passengers who flock to it in the summer months.

They were eager, too, to ensure that it should be safe, reliable and modern. Perhaps the only element which seems old-fashioned is the full-size railway sleepers spanning the brick piers on which the elevated track is laid. But a moment's consideration shows that the wooden spans sit more happily in the rural setting than would concrete or metal ones.

Light aluminium alloy track is anchored to the sleepers by clout nails. "And we have never had any trouble with them since the day they were put in," the redoubtable Mr K. N. Harris, chairman of the SMLS, told me when I visited Beech Hurst recently in company with members of the Society of Model and Experimental Engineers.

How about slipping ?

"We have trouble with slipping only when visitors drop oil all over the track," said the SMLS treasurer, Don Charmbury, with an artful look in his eye.

But Mr Harris, who, by a quirk of events, is also chairman of the SMEE, and was, therefore, inviting and representing the visitors simultaneously, saw the fruitlessness of an argument with himself and took a long pull on his cigar.

Track circuiting controls the automatic three-aspect colour signals, though they can be manually operated if necessary. An illuminated train-indication diagram in the station building shows the position of any train and also the aspect of each signal. The electrical power is provided by a 12 v. direct current circuit transformed from the mains.

If need be, reverse running can be made, in which event the signal units are mounted on the other side of the posts—four-prong sockets being located each side to accommodate this facility.

Right: Traverser in action. In the left-hand corner is the turntable and on the extreme right the water tower. Under the tank, enclosed by a white box, is the steaming-bay telephone. The long straight run on the right leads to the Beech Hurst platforms. Left: Ann Carter shoots under the bridge

In some instances—as, for example, on the approach to the traverser—the signal unit has to be transferred to another post on the other side of the protected object.

An ingenious device is the ghost train—not the fictional creation of Arnold Ridley, but an electronic train to interest the lone driver, who, without it, would find a monotony of green signals all the way. An electrical system produces a behaviour pattern in the signals similar to that of an actual train, and the lone driver needs to keep his mind alert and not just open the regulator and enjoy the view.

Incorporated in the signalling system is a warning bell which clanks imperiously if anyone is nitwitted enough to open the traverser when a train is approaching.

The traverser is a fine piece of engineering. It is itself set on a track which allows the span, long enough to accommodate the largest 5 in. gauge engine and tender, to be withdrawn to the lines in the steaming bay.

The withdrawable span is held accurately in running position by locking pins. To release the pins, the whole span is raised by turning a hand-wheel which engages a low-gear worm drive.

The first track in the steaming bay houses the turntable, a simple but effective device comprising a metal span pivoting on a central column. Its action is delightfully smooth and accurate, a tribute to the painstaking work of its constructors.

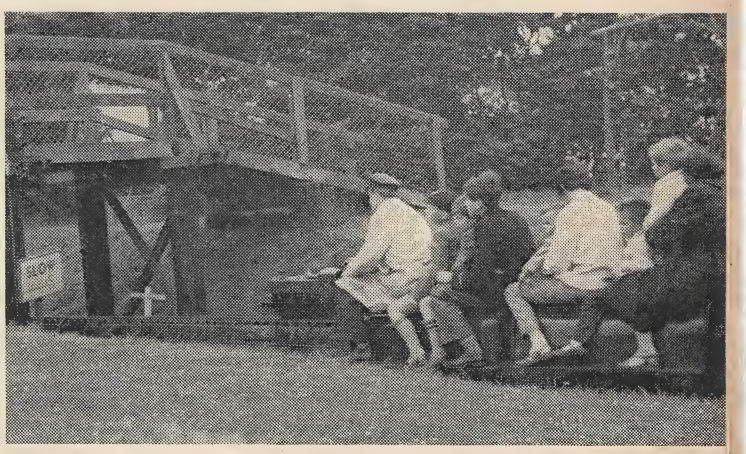
Each bay is equipped with a 12 v. d.c. electrical socket from which operators may draw current to drive fan blowers. Power for these comes from a battery replenished by a trickle charger.

In the bay, too, are the water tower and one of the three telephones which allow communication throughout the track. The other two are in the station and the engine shed. A simple system of call-buzzes dispenses with expensive ringing apparatus.

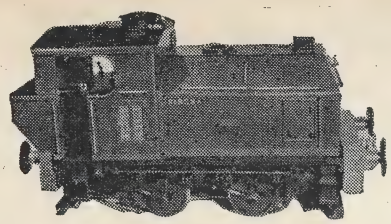
It is eight years since the Sussex Miniature came to Beech Hurst and in that short time it has been established as one of the premier lines in the country. Like all successful projects it has meant some serious thinking and hard work, most of which has fallen on the broad shoulders of Eric Rowland, Arthur Elphick, Alan and Mike Killick, and the hard-working secretary, Mr S. R. Bostel, the nucleus of the permanent way gang and maintenance staff.

You will enjoy a visit to this attractive miniature line. And you will get a warm welcome from the hospitable members of the society. If it is wet—do not worry. There is a cosy little club room behind the engine shed where live-steamers can swap yarns till the clouds pass. ▣

Three-aspect signal at entrance to Beech Hurst station. Just behind is one of the several hydrants erected on the platform



Visiting drivers on their first trip need a quick eye at the bridge, where a Slow sign, a gradient post and a three-aspect signal are all sited together. D. E. Lawrence, a SMEE visitor, approaches with practised ease on a SPEEDY



SIRENA Continued from June 8, pages 720 to 722

WHEELS and AXLES

J. J. CONSTABLE reaches the tenth instalment of his serial on the 5 in. gauge Sentinal steam locomotive

PHOTOGRAPH 25 shows the spring hangers on a Sentinel which I was able to photograph in my own district. As some will notice that the brake rod arrangement is different from the one on the model, I must explain that the photograph is of a 200 h.p. engine; the spring hangers are the same for the 100 h.p. and the 200 h.p.

Details of the spring hangers on the model and their location on the frames are seen in Fig. 54; modellers will have gained a fair impression of them from the earlier pictures. Castings can be had. They will need only drilling and filing to shape.

While the small hangers are all the same, two right-handed and two left-handed are required of the larger size. All four hangers for each side were fabricated in one strip and then cut and filed to length and shape. For the body a 4 in. length of $\frac{1}{2}$ in. $\times$ $\frac{7}{16}$ in. was slotted to a depth of $\frac{5}{16}$ in. by a $\frac{1}{4}$ in. dia. end mill, with the 4 in. length held in the vertical slide. For the back piece a 4 in. length of 1 in. $\times$ 3/32 in. brass was used. The webs were made from $\frac{1}{16}$ in. wide slices parted off from a 1 in. dia. brass bar.

All the parts were silver soldered at the one heat, but to keep the webs in place during the operation shallow slots $\frac{1}{16}$ in. wide were cut in the body. The back was also pinned to the body at each end with $\frac{1}{16}$ in. dia brass pins. Only a little silver solder was used, enough to form a fillet round the webs and give the finished article the appearance of a casting. The $\frac{1}{8}$ in. dia. hole will carry the pin for the torsion bars which go right through into the frame and can be drilled either before or after the hangers are riveted to the frames. The completed hangers are held to the frames with 3/32 in. dia. steel rivets. Their location is shown, but the hole specially indicated on the drawing should not have a rivet at this stage, for if a built-up mechanical pump is employed a dummy rivet is later placed in the hole and used to secure the mechanical pump to the frame.

In the close-up of the two centre hangers on the near side of the model in photograph 26 the hole can just be seen, together with three 6 BA countersunk holes in an arc. All these hold the built-up pump in position. The other two countersunk screws keep the running board support to the frame. The other hole is a bush into which an adaptor can be screwed to connect to an air line for quick steam raising.

It is obvious that all the hangers, when they are riveted to the frame, should be in line. I found it helpful to place a length of $\frac{1}{4}$ in. $\times$ $\frac{1}{4}$ in. square bar in the $\frac{1}{4}$ in. slots of the hangers and use it as a guide in riveting. All the rivets should be countersunk on the inside of the frames and filed off flush.

You will see details of the running board supports in Fig. 55. The slots were cut from a piece of angle iron of $\frac{1}{8}$ in. gauge. The small $\frac{1}{4}$ in. $\times$ $\frac{1}{4}$ in. stub is required to take the sanding gear. It is made from a piece of $\frac{1}{4}$ in. square mild steel, slotted $\frac{1}{16}$ in. and then tapped 8 BA on the underside and No 43 hole at the top.

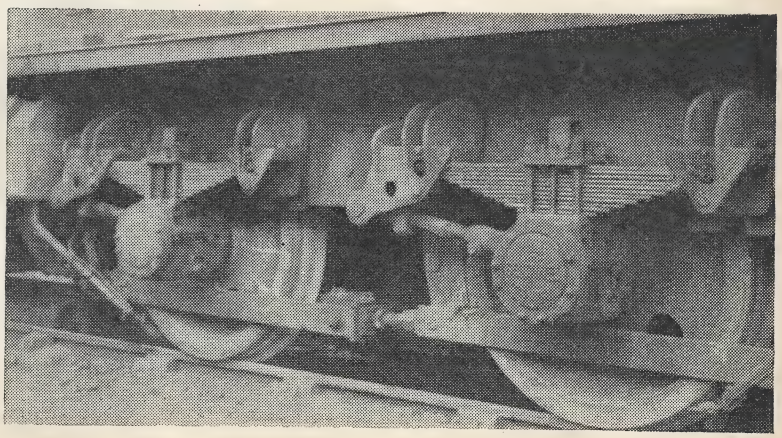
In brazing the two parts together it will be found helpful to leave a pip on the $\frac{1}{4}$ in. square bar when this is parted off. The pip can then be located in a small hole drilled in the angle piece for silver soldering.

The completed brackets are held to the frames with two 6 BA countersunk screws. The holes in the frame already drilled should be used as a guide for drilling the brackets, whose top should be $\frac{1}{16}$ in. below the level of the frames.

Photograph 27 shows the completed wheels on their axles with sprockets in place (hidden by the wheels nearer to the camera) and the pump eccentric, strap and rod. My own wheels were made from $\frac{1}{2}$ in. thick mild steel, but castings are obtainable. Fig. 56 shows the details of the wheels and of the axles made from silver steel.

I have shown the diameter on the back of the wheel as 1 in. Although this is not critical, all the wheels should have the same size boss. This will eventually locate the chain sprockets. It should, of course, be concentric with the axle hole in the wheel.

While the method of turning wheels is to some extent a matter of choice, I suggest that the casting or MS blank should be held in the chuck with the face outwards and the jaws holding only on the part which will eventually be the flange. A cut is first taken across the face. Then the tread is turned down to about 10 thou oversize and the recess in the face is turned at the same setting. After the wheel has been reversed in the chuck, the back is turned down for the sprocket boss, left 10 thou oversize, and finally drilled and reamed $\frac{1}{2}$ in. dia. for the axle.



Photograph No 25: Layout of spring hangers on the full-sized engine

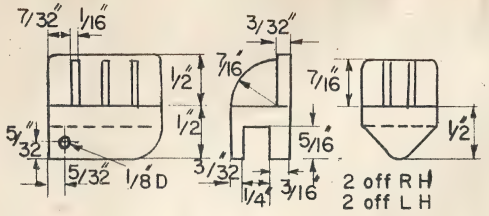


FIG 54 Bronze

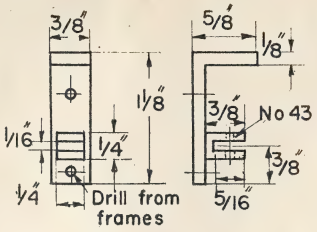


FIG 55 MS

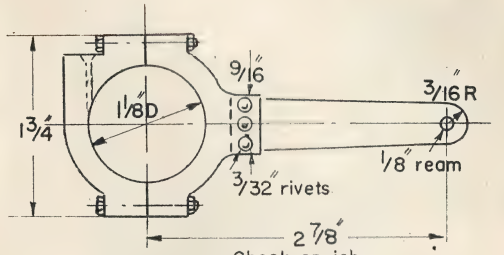
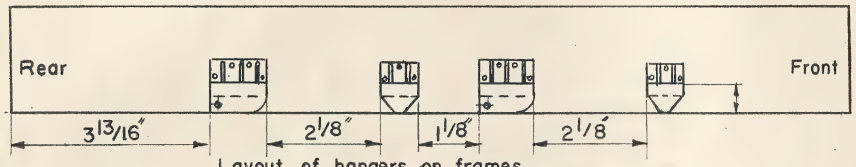


FIG 58



Layout of hangers on frames

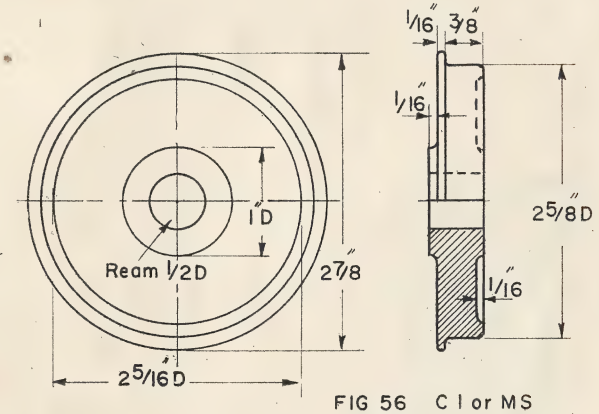


FIG 56 C I or MS

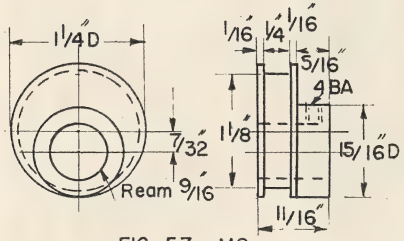


FIG 57 MS

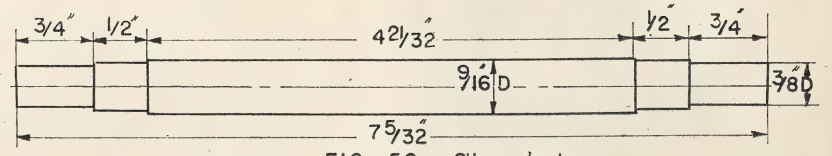
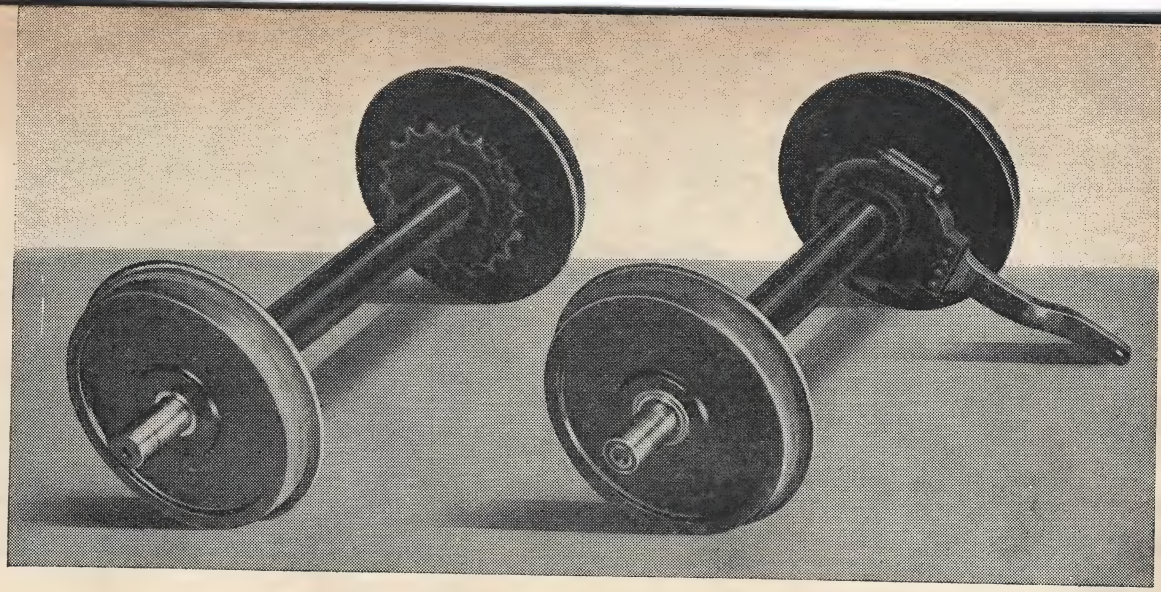


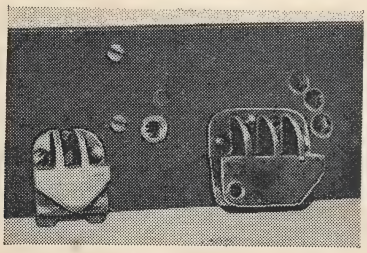
FIG 56 Silver steel



Photograph No 27: *Wheels on the axles, with pump eccentric and strap and one of the chain sprockets—which some will make and others buy*

All the other three wheels should be handled in the same way. Do the clearing up to exact size on a mandrel made from a piece of mild steel bar, about $\frac{3}{4}$ in. dia., so that it looks like the end of the axle. The last $\frac{3}{8}$ in. dia. should be threaded $\frac{3}{8}$ in. BSF or Whit. The wheel seat should have a good finish and be of such a diameter that the wheel will just wring on without any shake.

Keeping the mandrel in the chuck, mount a wheel, lock it in position with a nut, and take the final cuts off the wheel tread. Do all four wheels at the same setting of the tool in the cross slide. Then finish off all the flanges with a cut, but before removing them



Photograph No 26: *Model hangers*

from the mandrel round off the edges with a smooth file. In these circumstances, never use a file without a handle.

The final operation on the wheels is to take the last cuts for the 1 in. boss on the back. This again should be done at the same setting of the tool for each wheel, for ease in fitting the sprockets. In all such final operations you are wise to have the tool sharp before you begin.

While the axles are made from $\frac{9}{16}$ in. dia. silver steel rod, mild steel would be a passable substitute. The rod should be cut to the length required, allowing sufficient for a facing cut to be taken at each end, which at the same time should be centred. All turning of the axles is better done between centres. Get a really good finish on the wheel and bearing seats. I find that a sharp parting tool used with plenty of suds will produce the high finish needed to give trouble-free running for a long time.

The need for a good finish on the wheel seats is to make sure that when the wheels are pressed on they will stay there for good. If a rough finish on the wheels or the axles is present when the wheels are pressed on, it is likely that the wheels will eventually become loose, because the turning ridges, after offering resistance at first, are smoothed down in the pressing on. To make the wheels go right up to the shoulder on the axle it is advisable to countersink them slightly before assembly. We cannot do this until other parts are made.

Fig. 57 provides details of the pump eccentric. Holding a piece of $1\frac{1}{4}$ in. dia. MS bar in the chuck, I faced the end and at $\frac{1}{16}$ in. from the end turned a $\frac{1}{4}$ in. wide groove to a diameter of $1\frac{1}{8}$ in. Here, too, the finish was important in giving the eccentric strap a useful life. The bar was parted off to a length of just under $\frac{3}{4}$ in. This was marked with a centre pop 7/32 in. away from the centre, seen from the tool marks made in parting off. It was then set up in the four-jaw chuck so that the centre pop ran true, and was drilled and reamed (it can be bored to $\frac{9}{16}$ in. dia. to fit the axles) and turned down to the size shown. A final facing cut brought it to size.

Care should be taken in all this process that the slender sides of the groove are not damaged by the chuck jaws. If a protective piece of $\frac{1}{4}$ in. wide strip of brass is wound in the groove to exceed the diameter of the cheeks, the chuck jaws will tighten on it and no harm will be done.

The eccentric was drilled and tapped 4 BA to take the socket headed grub screw. Any burrs produced in the bore were carefully removed.

Details of the eccentric strap and rod are seen in Fig. 58. A casting can be had for the strap, but if you have a suitable one in stock you can, of course, use it. A way to make the finished strap is to hold the casting in the vertical slide, drill for one of the bolt holes with a No 42, and at the same setting face off or counter bore, so that the bolt head will have a square surface on which to seat. Without removing the casting from the vertical slide, advance the cross slide so that the other hole can be treated likewise. When this has been done, reverse in the vertical slide. Face off or spot-face seats for the nuts. At the same time the $\frac{1}{8}$ in. wide slot can be cut with an endmill to take the end of the eccentric rod.

The eccentric can be cut in half with a fine hacksaw, and the sawn faces cleaned up, or flycut for preference, to get the face square with the body. The two holes in the strap part are tapped 6 BA. The two in the oil hole part of the eccentric are opened up so that the 6 BA bolts to be used will just go through. You will probably find that a number drill smaller than the size given in the text books can be used. The size can be determined by measuring; the bolts should be a snug fit.

Both parts of the eccentric should now be bolted tightly together for boring the central $1\frac{1}{8}$ in. dia. hole.

● *Continued on page 788*

READERS' QUERIES

DO NOT FORGET THE QUERY COUPON ON THE LAST PAGE OF THIS ISSUE

This free advice service is open to all readers. Queries must be within the scope of this journal and restricted to one problem. The replies published are extracts from fuller replies sent through the post: queries must not be sent with any other communications: valuations of models, or advice on selling cannot be given: stamped addressed envelope with each query. Mark envelope clearly "Query," Model Engineer, 19-20 Noel Street, London W1.

American lathe

I have recently acquired a fairly antique American centre lathe; 4 in. with twin leadscrews and full set of change gears, treadle driven. I have now done it up and it is in not too bad a state. The problem is, what to make. I have little or no interest in steam and tend towards a four-stroke petrol engine.

As I am only very much a beginner in this type of work (having previously restricted myself to electrics, OO gauge railways and model ships) I wonder if such an engine would be beyond my capabilities.—P.R.A.D., Esher, Surrey.

▲ *It would appear from your description that this is a Barnes lathe, very popular some* 40 *or* 50 *years ago and long out of production. It should be quite suitable for general model engineering work, and the projects which you suggest could, in our opinion, easily be carried out with the assistance of such a lathe.*

As you have not had a great deal of experience, a single-cylinder petrol engine would be a very suitable subject for a first attempt. The Kiwi *engine, recently described in detail in ME, would be suitable. Castings can be obtained from Woking Precision Models Ltd,* 32 *Mount Hermon Road, Woking, Surrey.*

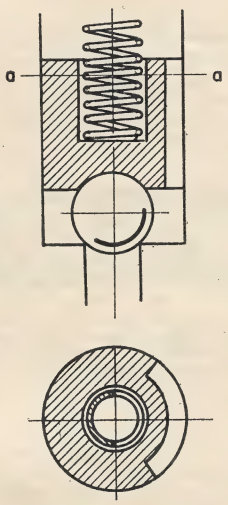
A fretwork machine or jig-saw would also be fairly straight-forward. PM Plans Service can supply detailed blueprints (WE4, 4*s.* 6*d.) of the jigsaw attachment for the lathe which could easily be adapted for fretwork. There are also blueprints for a sensitive drill, but the major operations on the castings would be a little difficult for a beginner.*

Working model diesel or petrol locomotives and also scale model cars are again somewhat difficult. PM Plans Service can supply several detailed drawings of traction engines. The ME 1 *in. scale steam-driven traction engine is recommended.*

Enough oil ?

I have just mounted the boiler on the chassis of my *Tich*, and given it a steam test. But I find that the mechanical lubricator seems to be not delivering oil properly to the cylinders. I understand that there should be an oily appearance around the top of the chimney, and from the cylinder glands. I have not found this to be so, except for a slight greasy film of ash inside the chimney when a finger is rubbed inside, after the run. Is enough oil getting to the cylinders ? The top of the chimney is quite dry in running.

I do not know of any other way of telling if oil is getting to the cylinders. When I made the lubricator to LBSC's drawings, I found that it was able to force oil past all the pressure that I could apply to the outlet with my finger, as LBSC suggested. The ratchet wheel is as specified, and



Section a-a

clicks one tooth for every revolution of the wheels as specified. I cannot increase this by moving the drive to any hole on the ratchet lever.

There is one other point which makes me think that some oil must be getting past the steam T-pipe check valve—a very slight seepage of oil, which I noticed after the run, around the threads of the steam T-connector to the left-hand cylinder. I am enclosing a drawing of what I mean. Can you please suggest what is the trouble ?—F.J.B., Stoke Aldermoor, Coventry.

▲ *From your description, it sounds as if sufficient oil* is *reaching the cylinders of your* TICH *locomotive.*

If you feel doubtful, fit an additional check valve between the lubricator and the check valve on the steam T.

The check valves should have a ball, kept on its seating by a light spring (32 *s.w.g.). If you can arrange for a loose plunger to bear on the ball rather than on the spring itself, so much the better.*

Reducing power

I have a 28 v. d.c. motor (compound wound) rated 0.3 h.p. There are three leads, positive, negative and field.

As I require only about 1/6 h.p. I propose, if possible, to run the motor at reduced input voltage. I have a heavy duty transformer whose higher tappings are 15, 18, 19, 21, 22 and 24 v., all at 6 amps.

Allowing for a quarter voltage drop on the rectifier (limited to 24 v., 6 amp.) what resistance wire gauge should I introduce in the field lead and what number of ohms ?

What voltage tapping should I use to give about 1/6 h.p., and what gauge of wire and number of ohms if I require a cutout resistance to protect the transformer and rectifier from overload when the motor is on load ?

The motor turns over at 7,400 and is reduced to 440 by compound gearing.—R.K., Isle of Man.

▲ *Is the rectifier a separate unit to the transformer, or are you proposing to build a rectifying unit* ?

A rectifier having an output voltage of 24 *v. needs an input voltage to the rectifier of* 30-32 *v. Of course the rectifier can work with a lower voltage input, and for* 12 *v., as an example, the input voltage would be roughly the* 21 *or* 22 *tap on your transformer. The limiting resistance should be sufficient to carry the whole output current of the rectifier. This has nothing to do with the output voltage supplying any apparatus.*

The resistance would be about 4 *ohms. An additional resistance as a variable in series with the limiting resistance would give a range of current controls; a number of commercial rectifier units are constructed in this way. If you adopt the method, you will be able to control the current taken by your motor to the required limit. The gauge size can be either* 18 *or* 20 *s.w.g. nickel-chrome resistance wire, wound as an open spiral in free air.*

Model Engineer EXHIBITION

The next Model Engineer Exhibition will be held at the Central Hall, Westminster, opposite Westminster Abbey, from 16-26 August 1961, excluding Sunday. Anyone wishing to enter a model, or other piece of craftsmanship, should write to the Exhibition Manager, Percival Marshall Ltd, 19-20 Noel Street, London W1, for an entry form.

Resistance placed in the shunt field coils of a motor is for the purpose of speed control; to add resistance will increase the speed. The series winding on the motor is incidental here; it is for the specific purpose of enabling the motor to start straight on the supply without having to use a starter. A shunt wound motor is not self-starting under a direct connection to the supply. This might not apply with a very small motor, but with a machine taking a current in the higher range the effect is a short circuit at the instant of switching on, because of the heavy armature winding, and a very weak field. In starting a normal shunt or compound motor, the shunt field is excited first, before any current is allowed to pass to the armature. The motor will start with any appreciable current rush.

Firing trouble

Would you be so good as to help me out, if possible, as you have on other matters in the past ?

I am an enthusiast for live steam—particularly O gauge locomotives and marine engines of similar size. My trouble has always been the firing arrangements. I cannot get any but the simple methylated lamps to work.

Some years ago there was a lamp or burner by Mr Blakeney which used paraffin raw—not under pressure. I think it was blown by air or steam from the boiler.

I have wasted an enormous amount of time and have not progressed one inch on this—L.A.K., East Sheen, London.

▲ *With the Blakeney oil burner, you would have to do a good deal of experimenting on jets to obtain satisfactory results. The steam jet would probably have to be* 0.010 *to* 0.012 *in. diameter.*

Another oil burner which might suit your purpose is the diffused-flame type designed by Edgar T. Westbury and illustrated in the Manual of Model Steam Locomotive Construction. *The mixing tube could be made shorter than is shown, according to the length of your firebox.*

Air pump for Lassie

I intend fitting a small air pump to my *Hielan' Lassie* to supply air for brakes on the train. The pump being driven from the crosshead, would be 5/32 in. bore × $1\frac{5}{8}$ in. stroke. As the engine will work on a continuous track, I think a small bore would be sufficient. The air tank will hold only 16 cu. in. of air at 30 p.s.i. Do you think that the pump would be suitable for this size tank ?—B.J., Westbourne Grove, London.

▲ *Your air brake reservoir should be quite satisfactory, but you may be better advised to make the air pump* $\frac{3}{16}$ *in. bore.*

Too small a bore would mean too long a waiting period before the pressure built up to 30 *lb. again, after a brake application.*

Can You Help ?

Readers who can offer information to those whose queries appear below are invited to write c/o Model Engineer. Letters will be forwarded.

Taper angle

I am constructing a $\frac{3}{8}$ in. bench drill from castings (Reeves) and I have a new $\frac{3}{8}$ in. Jacobs drill chuck which I intend to fit on the machine.

The spindle of the drilling machine will be $\frac{3}{8}$ in. dia. when completed, and one end is tapered to suit the internal taper of the drill chuck.

It is the angle of the internal taper which is giving me trouble, because I have no means of measuring it, and the rough tapers which I have turned in experiments have been unsatisfactory.

Could you please tell me the angle of the internal taper ? I would be very grateful for any hints which would bring this job to a quick and satisfactory conclusion.—R.G.H., Worksop, Nottingham.

▲ *The taper angle for this chuck is not mentioned in any reference books.*

Probably the angle is about $\frac{1}{2}$ *in. to the foot, which is slightly less than* $2\frac{1}{2}$ *in. included angle. It should not be difficult to find the correct taper by trial and error, using a piece of scrap material for testing.*

A satisfactory method is to turn the taper as nearly correct as possible with a smooth surface, smear it lightly with marking colour, such as red ochre or Prussian blue, and try the chuck on it. The colour will be removed on the high spots and further correction on the angle of the slide rest should then be made with repeated tests until the colour is removed all over the surface. The test piece will also enable the diameter at the large end to be properly measured.

Who knows the taper angle beyond doubt ?

Sirena . . .

Continued from page 786

This is done in the four-jaw chuck. Take care to place protective material where a tightened jaw can maul. After boring, mount the strap on a mandrel and face it off to a total width of $\frac{1}{4}$ in. to fit the groove in the eccentric. In turning grooves it is often difficult to get a good square shoulder, and the strap when it is fitted may appear tight though it is bearing on only part of the surface. I generally take a small scraping off the strap at the edges and this avoids any trouble. A light skim of the sharp edges with a scraper is all that is required.

The eccentric rod is cut from a piece of $\frac{1}{8}$ in. gauge mild steel plate. As the length of the finished rod will depend upon the mechnical pump to be used, the rod should be made about $\frac{1}{4}$ in. longer than is shown in the drawing and the $\frac{1}{8}$ in. dia. hole should not be drilled until the correct position can be determined from the actual job. The rod has an offset of 7/32 in. and make sure that the faces are parallel. You can easily do this by holding one side down on a surface plate, or even on the lathe bed, and blancing a piece of square bar on the other. Any discrepancy will soon be seen and should, of course, be corrected.

To hold the rod to the eccentric strap, the end is first tinned and then soft-soldered into the $\frac{1}{8}$ in. slot in the strap. Three or four 3/32 in. dia. rivets (depending upon the strap used) are put in; after they have been riveted over, the job is again warmed up until the solder runs, so that any cracks which may have been made by the riveting process are made good.

In the next instalment I will deal with the chain sprockets and describe them fully. Those who do not wish to tackle this work may buy the sprockets. I mention this now so that no-one will be nervous.

★ *To be continued on July 6*

POSTBAG

The Editor welcomes letters for these columns. A PM Book Voucher for 10s. 6d. will be paid for each picture printed. Letters may be condensed or edited

WATT'S IDEA

SIR,—Who invented the micrometer? I say that James Watt invented it.

Some years ago I went on a visit to Tangyes at their Smethwick works to see the James Watt relics, which were kept there before they were handed over to Birmingham University.

One of the exhibits was a micrometer made by the engineer and claimed to be the first. The man in charge of the relics, which included some of the original drawings, knew the life of James Watt from birth to death, and I cannot imagine that he would have made a false claim.

Another exhibit was an indicator for taking indicator diagrams of the steam during the workings of steam engines. This was, I think, claimed to be the first. Another point, which is known more generally, is that James Watt determined the mechanical horse power of 33,000 ft./lb. a minute.

My visit took place about 1908. I have been a reader of MODEL ENGINEER since 1906 and have enjoyed it.

Smethwick, Staffordshire. A. W. EDWARDS.

ALBERTA PLEA

This is a real down-on-my-knees plea to you.

In ME of April 13 Mr J. S. Reid called for information on 3 in. scale traction engines. I have been continuously a reader since 1907 and I have issues back as far as 1902. Nothing would please me more than a *new series* on model traction engines of the larger scales, in view of their growing popularity.

Naturally, the technique and art of model engineering has advanced greatly since those 1909 articles were written. I would like the pleasure of reading a series by, say, Mr G. K. King of Norwich, who is a clever man, and has had much traction engine experience; or Mr George Eves whose traction engine story "Steam in His Veins" we all loved very much.

I am a dyed-in-the-smokebox traction engine fan, and I think that you would do yourselves and your readers much better with a new version which encouraged fresh approaches, albeit the traction engine is far from new.

Nor, for that matter, is steam new at all. But just look what men like K. N. Harris did for the stationaries and what LBSC and Martin Evans have done for the steam locomotive. So I think an up-to-date approach would reflect well on your magazine (we all love it) and would introduce new methods of constructional technique to a worthy example of the days of steam transport.

See what you can do for us please. Wishing you continued success.

Nemiskam, Alberta. C. A. BUTTERWICK.

INJECTORS

SIR,—With the temerity of those who rush in where angels fear to tread, I think that Mr K. N. Harris is way off the mark with his injector theory [Postbag, May 18].

First, it would seem that any velocity imparted to the water would, when converted to pressure again, be exactly the same as, or even less, than the original pressure.

Secondly—and here I take my stand—Mr Harris leaves out the question of the temperature of the feed water. It is well known that an injector will not work with hot feed

OLD BARCLAY

SIR,—An 0-6-0 colliery engine built in 1900 by Andrew Barclay Sons & Co. Ltd, Kilmarnock is working at Newdigate Colliery, Bedworth, near Nuneaton in Warwickshire.

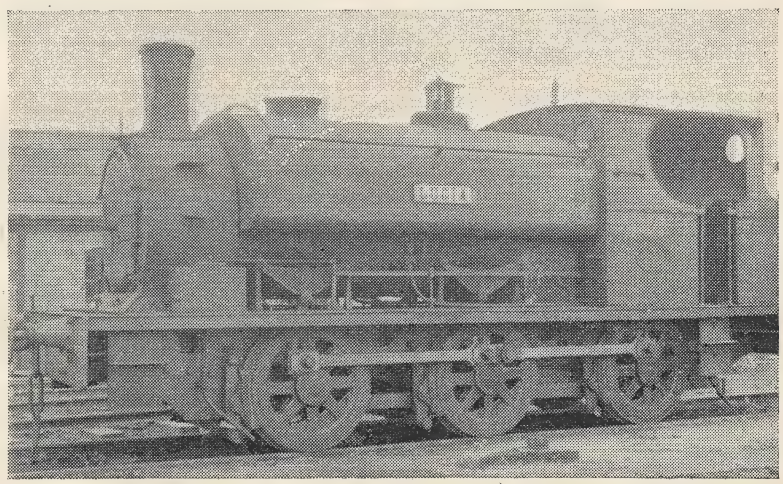
Its wheels are massive, with H section spokes, the cylinder lubricators are fitted low down on the smokebox front, as on the old Caley Pugs, and a couple of bracket steps fitted to the side of the smokebox, enable the driver to get at the tank filling cover.

I noticed that one rear sanding pipe had evidently caught some obstruction. I was delivering sand, about 18 in. away from the wheel.

I understand, that the engine was called after a lady who still resides in the district.

The photograph was taken on a damp and foggy morning.

Newcastle-on-Tyne E H JEYNES



It was a damp and foggy morning when E H Jeynes spotted a Barclay colliery engine of 1900 still working at Bedworth, Warwickshire. The engine is said to have been called after someone who is still alive

water, and surely this gives greater weight to LBSC's idea that it is the condensation of the steam in the feed water which gives the astonishing increase in pressure.

Richmond, Yorkshire. L. BOLAM.

SIR,—In reply to the recent correspondence on the theory of the injector, I would stress that the atmospheric pressure on the water in the tank in fact plays an active part in the successful working of the device. The proposition that it gives boost to the boiler pressure is, of course, entirely fallacious, but there can be little doubt that it is the atmosphere that causes the water to enter the low-pressure gap between the steam cone and the combining cone. In the case of a lifting injector, the atmosphere has to overcome the standing head between the tank and the injector itself, and if this distance is excessive the instrument will not work, as any old engineman will confirm! It is the thermal energy in the supply steam which actually does the work! Atmospheric pressure is merely the detonator.

Saffron Walden, Essex. S. W. NEVILLE.

ON THE ROAD

SIR,—It is surprising that Vulcan should take the line which he took in Smoke Rings of June 1 on the method employed to move a traction engine to Great Wymondley rally.

The driver deserves much credit for his courage in taking the engine out the Whit week-end.

Most people who own an engine do not own a low-loader as well and could not afford to hire one.

An engine for which the Road Fund licence has been paid is quite as much entitled to use the Queen's Highway as any other vehicle, and is no more of a nuisance on the road than are cyclists, cattle, sheep, or bad car drivers.

An engine on the road is relatively rare anyway.

Bellingham, Northumberland. J. L. MIDDLEMISS.

WHAT SANK HER

SIR,—The picture of the *Queen Elizabeth* sitting on the bottom of the Thames [Postbag, April 13] was taken from Kew Bridge looking down river, I believe, in 1902 or 1903.

I saw her exactly as in the photograph. She struck a submerged pile left from the temporary wooden bridge used while the present bridge was being built.

The present bridge was opened by King Edward VII, to the best of my recollection in 1903, and the wooden bridge was demolished before the opening day.

Queen Elizabeth was a queer looking craft of narrow beam. I believe that the paddle wheels were driven by a two-cylinder oscillating engine.

The steamer used to go to Richmond through the tidal lock. I imagine that this was the reason for her narrow beam. She was one of the most ungainly looking craft I have ever seen.

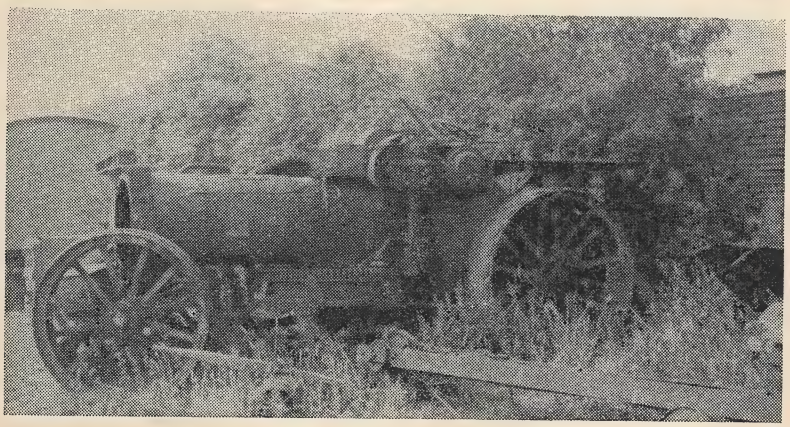
Secretary, Luton and District SMEE. H. D. BOND.

MORE CONVERSIONS

SIR,—In July, 1959, I passed the premises of Bomford and Evershed, Ltd, and saw a number of steam rollers stabled in their yard. They were all the genuine article [Postbag, March 30].

Adjoining Bomford and Evershed's works are those of Bomford and Wilkins Ltd, who own a number of Fowler ploughing engines. Near the entrance stood No 15133, registration number CF4073. The engine was built as a compound steamer, but had had chimney, cylinders and motion removed. A 75 b.h.p. diesel engine had been mounted on the boiler, over the front wheels. The conversion was carried out by J. & H. McLaren Ltd, of Leeds in 1937-8.

In another part of the yard was a Fowler built as a single cylinder ploughing engine about 1900. The makers' number plate had been removed and the plate of Bomford and Evershed substituted; it bore the date 1947. Chimney, cylinders and



T. C. Vickers saw these two converted Fowler engines at Salford Priors in Warwickshire. Top: 15133. *Above:* 4680

motion had been removed and a diesel engine was mounted in the tender in the space normally occupied by the bunker and water tank.

I understand that the company own other hybrids. The reason for the conversions was the same as for the conversion of the steam roller owned by the neighbouring company.

Ockley, Surrey. T. C. VICKERS.

PIONEER OF ROCK ?

SIR,—E. A. Langridge's article in MODEL ENGINEER of April 27 on eight-wheel coupled engines is of much interest to me as a locomotive man. It deals with many engines which I fired and drove. My career began with the old Great Central Railway many years ago, and I was brought into contact with the splendid and sturdily built J. G. Robinson 0-8-0 and 2-8-0 engines.

They were reliable, economical and easy on maintenance and were highly capable of hauling heavy freight trains. The 0-8-0s were known as "Old-fashioned Ladies" and the 2-8-0s as "Tinies" probably because when they were first built in 1911 they were large by the standards of that time.

Coal traffic between 1911 and before the second world war was plentiful and heavy. The 2-8-0s were loaded to 56 wagons of all sizes on the trains plying between South Yorkshire and Woodford. Often when the engines arrived at Leicester their fires would be dirty, but all we did was to run the long straight dart iron through the fire to loosen the clinker, before we set off over the very heavy gradients to Woodford. We had no difficulty with steaming. At times of power shortages, the 2-8-0s were often used on passenger trains. I well remember one which worked a special to Wembley in 1924.

The usefulness of the GCR 2-8-0s was recognised by the War Department in the 1914-18 war, when no fewer than 521 were built for war service, 311 of them going overseas.

As practical men, we did not find the GNR 0-8-0s, known as "Long Toms," a versatile type. They were inclined to be sluggish and very heavy on coal and water. They did not take to the heavy GCR gradients very well, and were terrors for slipping. There was much steam wastage at steam chest and cylinder cover joints, to say nothing of the amount leaking at valve spindle and piston glands. One old driver used to say that an extra boiler of steam was required for these defects.

I found the pioneer three-cylinder GNR 2-8-0 No 461 a very peculiar engine. Its valve events were erratic. There was one heavy exhaust with five various exhausts chasing it. When the engine was negotiating curves, the exhausts went anyhow, causing the engine to lose speed and make very heavy work of getting the train over. Perhaps the conjugated gear was the cause.

The two-cylinder GNR 2-8-0s were reasonably good and put up performances very often far superior to the three cylinder engines.

Mr Langridge's mention of bridge testing takes me back to Sunday 13 July 1924 when, as a fireman, I was booked with a driver to take L and YR 0-8-0 No 1456 on bridge-testing duties which were being carried out by the Bridge Stress Committee under Professor Dalby. The bridge to be tested was the one which carries the GC main line over the old L and NWR at Rugby. Single line working over the down line was in operation. We used the up line for the tests, and speeds ranged between six and fifty miles an hour. No 1456 was slack-coupled between the engine and tender, which caused us to have very rough rides, such as we were not used to on GC engines. You could say that 1456 was the originator of Rock 'n' Roll.

Many classes of engines were used for bridge-testing, GC 4-4-2 No 264 was on the same work. No 5360 was fitted with a Flaman speed recorder and went to various places in England testing bridges. On 20 July 1924 I was on the work with a GCR three-cylinder compound, No 364 *Lady Faringdon.*

The full story of eight-wheel coupled engines has not yet been told, but every little helps. What times I had on them ! My experiences with the old H and BR 0-8-0 are still fresh in my mind, too.

I wish ME every success.

Braunstone, P. H. V. BANYARD.
Leicester.

NEW POND

SIR,—A new model yacht pond is being made in the little park by Colin Deep Lane, Hendon, London. It has a bottom of cement.

Whether if will do well for sailing boats I do not know, because the place lies in a hole where only north or south winds have much of a chance.

Any pond which is stagnant, or smells, or becomes the breeding place of gnats, can be the subject of action on complaint by householders, under the Public Health Act 1936, a copy of which can be had from Her Majesty's Stationary Office for a shilling or two.

Mill Hill, H. H. NICHOLLS.
London.

LOCO LIBRARY . . .

Continued from page 780

unless the load is exceeded and a 4700 is used.

Out of the total of nine locomotives, six are based in London. They are Nos 4700, 4701, 4702, 4704 and 4708 at Old Oak Common and No 4707 at Southall. Of the remaining three, Nos 4703 and 4706 are at the St Philips Marsh depot in Bristol and No 4705 is at Laira Depot, Plymouth.

Ten years ago Old Oak Common also had five, Nos 4700, 4701, 4702, 4705 and 4707. At that time No 4703 was based on Laira. No 4704 was at Birkenhead, which is a Midland depot but has a reasonable complement of Western locomotives—indeed it was one of the haunts of the Dukedogs. No 4706 was based on St Philips Marsh, Bristol, as it is today, while No 4708 was up at Oxley.

Many thought that with the coming of the BR class 9F 2-10-0s, and the allocation of 55 of them to the Western Region, the 4700 class would disappear. But the class seems not to have been affected. It is the 2800 and 4300 classes which have suffered.

Again, many supposed that with dieselisation, Castles would displace Halls on some of the freight turns and the Halls would displace the 4700, but the trouble is that the Castles are not so powerful. It is possible that with the introduction of the freight diesels, such as the Beyer Peacock (Hymek) Type 2 hydraulics, on the Western, the 4700 class may be rendered obsolete, although I think it will be at least two years before the class is withdrawn. I believe that the smaller 2-8-0s, the Moguls and the 0-6-0s will be most affected by the advent of the freight diesel.

When 4700 appeared in 1919 it was painted in unlined green with black underframe. On the tender was the legend *Great Western.* There was no crest. During the 1930s the circular monogram with the letters GWR in it was used.

With the outbreak of war, unlined black was used for the whole locomotive with the letters GWR in either block or Swindon style capitals on the tender. During the war the crest again began to appear; it was placed between the letters G and W. After the war the unlined green with black underframe was again used and continued into nationalisation. Today the engines are painted in express livery and lined in the express style.

I should like to express my thanks to the Press Office of the Western Region and the shedmaster at Old Oak Common for their kind help. ▣

My next article will deal with the BR 9F 2-10-0s, and in particular No 92220 *Evening Star.*

CLUB NEWS

Send notes and news to The CLUBMAN, 19-20 Noel Street, London W1.

KASPAR'S WORK

WHENEVER the Durban SME News Letter arrives there is something happening to that wonderful track at Kellaway Park. The whole line has recently been overhauled and the club house has been repainted. Now the society is turning to other work, and in the near future a footbridge will be constructed to make it easier to cross the track.

By far the most important news of Kellaway Park is the project for a boating pool designed by Kaspar Nanni. It will be 80 ft in diameter and 18 in. deep and will hold approximately 46,500 gallons of water. At one end will be jetties 6 ft long × 5 ft wide where it will be possible for a person to stand up while trimming craft and raising steam. Backache will be unknown at Kellaway.

Another interesting project is the construction of a model of the historic engine *Natal*. The frames and well tanks have already been completed and it will be only two or three months before the motion and wheels are also ready.

South Africans certainly know how to work.

MORE MEMBERS

During a very successful year St Albans MES was greatly encouraged by a growth in membership. It now stands higher than ever before.

At the annual general meeting the Junior Proficiency Cup was presented to John Hodgson who, at 14, has done some really beautiful preliminary work on his 3½ in. gauge *Juliet*, including his own drawing. And then some of the older model engineers say that the young of today cannot model like the old ones !

Mr H. W. Saunders was elected chairman, Mr P. Lambert secretary, and Mr V. Vousden treasurer.

RODERICK DENNY

With deep regret I learn that the president of the Birmingham SME, Mr Roderick Denny has died. Mr Denny entered hospital recently and was stated to be improving.

It was only in March this year that the well-liked and life-long member of the society took over as president in the hope that he could guide the society through its difficult times while it has no permanent HQ.

His death is a great blow to the club. He was the sort of man who is found only very occasionally, always ready to do any task to the best of his ability and without complaint.

SOTON REGATTA

Some time ago I mentioned in these columns that because of lack of support in the model power boat section the Southampton SME had decided not to hold a regatta. This jerked life into the boat builders, and they have now produced enough evidence for the committee to reconsider its decision. They have decided that enough support is now forthcoming, and a regatta run under the auspices of the MPBA will take place on August 20 at the Ornamental Pond, Southampton Common.

The new steam track is now taking shape. On February 11 work began on the rail welding and sleeper fixing, by February 25 ten sections were completed and by March 11 140 ft of track was finished. A week later the mains water had been connected. By March 25, 112 sections were ready, and 260 ft of track laid, and by April 30 the base structure was completed and 510 ft of track was down. Since then another 100 ft of track has been laid. Plans are already in hand for the opening to take place on April 14 next. I hope that many model engineering societies will attend the opening.

Lone hands in the district are reminded that the society is meeting on Wednesday once a fortnight from June 14 at No 20 Carlton Crescent, Southampton, at 8 p.m.

RALLY ROUND

June 24 Northleach Rally. *Rally at Upper End Farm, Eastington, Northleach, Gloucester. Start at 2 p.m.*

July 1-2 Alton Towers Rally. *Rally at Alton Towers, 8 miles NW of Uttoxeter, Staffordshire. Organised by the North Staffs Traction Engine Club.*

July 1 Chatteris Rally. *Rally at Chatteris, Cambridge. Organised by the East Anglian Traction Engine Club.*

July 15-16 Rempstone Rally. *Rally at Rempstone, 30 miles NE of Loughborough.*

July 22 Redruth Rally. *Redruth is 9 miles SW of Truro, Cornwall.*

July 29 Kegworth Rally. *Rally at Kegworth, 5½ miles NW of Loughborough.*

July 29 Taunton Rally. *Rally at the County town of Somerset, Taunton, 44½ miles SW of Bristol.*

August 5-7 Woburn Rally. *Rally at the home of the Duke of Bedford, Woburn Abbey.*

August 7 Church Stretton Rally. *Traction engine rally at Church Stretton, which is 12¾ SW of Shrewsbury. Rally starts at 11 a.m.*

August 19 Weald of Kent Rally. *Rally organised by the Weald of Kent Traction Engine Club at Penshurst Aerodrome near Tonbridge, Kent.*

September 9 Kelvedon Rally. *Site is a mile along the main A12 from Kelvedon. Eastern National Omnibus Company buses pass the site.*

September 10 Basildon Rally. *Rally at the premises of Messrs Harold Wood at Basildon, Essex. Organised by the Historic Commercial Vehicle Club.*

CLUB DIARY

Dates must be sent at least four weeks before the event

June 22-24 17th National Threshers' Reunion Rally at Williams County Fairgrounds on Alt. US 20, Montpelier, Ohio, USA.

June 23 City of Leeds SME. Erection of the portable track at Crompton Parkinson Ltd at Guiesley.

June 23 Brighouse SMEE. Invitation to the Brighouse SME at Ravensprings Park, Brighouse and to the North London SME at Arkley.

June 24 Bristol SMEE. Running day at Cauford Park.

June 24 Birmingham SME. Visit to the Burton-on-Trent Brewery Railways. Leave Birmingham New Street 9.5 a.m. Fare 6s. 6d.

June 24 Lincoln SMEE. Track day at Boultham Park.

June 24 Sutton Coldfield MES. Summer outing to Whitney track at Blenheim Palace.

June 24 Leicester SME. Official opening of the track.

June 24 City of Leeds SME. Children's Day at Crompton Parkinsons, Guiseley.

June 25 York City MES. Track day at Rechabite buildings, Clifford Street.

June 25 YM 6 m. OA. Daniels Memorial Cup for A class vessels at the Rick Pond, Hampton Court at 10.30 a.m.

June 25 City of Leeds SME. Private running day at Temple Newsam.

June 25 Maidstone MES. Track day at Mote Park.

June 25 Blackheath MPBC. Regatta at Prince of Wales Lake, Blackheath. SR and SP.

June 25 Harrow and Wembley SME. Visit to North London SMEE at Arkley.

June 25 North London SMEE. Harrow and Wembley SME visit to Arkley.

June 26 Sutton Coldfield MES. Talk by George Dow of the Midland Region at The Swan, High Street, Erdington.

June 27 City of Leeds SME. Track meeting at Temple Newsam.

June 28 Blackpool SME. Meeting at Marton Working Men's Club at 7.30 p.m.

June 28 Harrow and Wembley SME. Pondside meeting at the West Harrow Recreation Ground at 7.30 p.m.

July 1 Colchester SMEE. Meeting at the Castle Park, Colchester.

July 1-2 City of Leeds SME. Open day at Temple Newsam.

July 1 York City MES. Co-operative Society Gala. Portable track in action.

July 1 Leicester SME. Track day at Abbey Park.

July 1 Cambridge MES. Public track day at Fulbrooke Road, Cambridge.

July 1 Hitchin MES. Visit to Cambridge MES track.

July 1 Cambridge MES. Hitchin MES visit, Fulbrooke Road.

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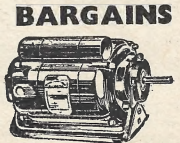

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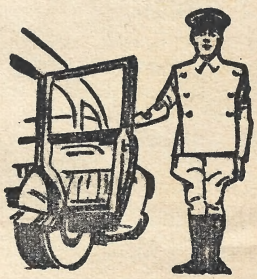

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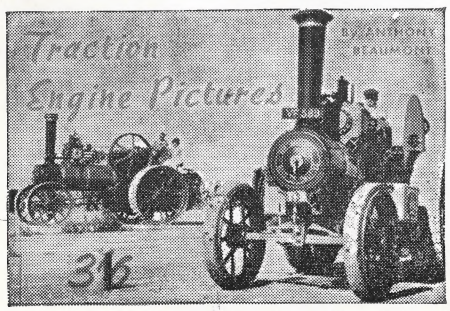

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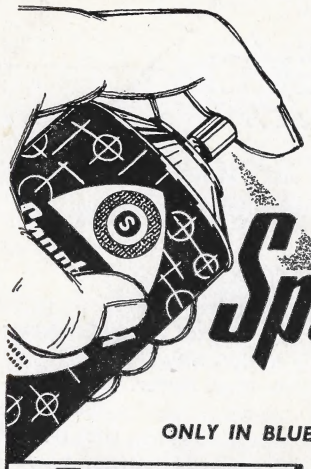

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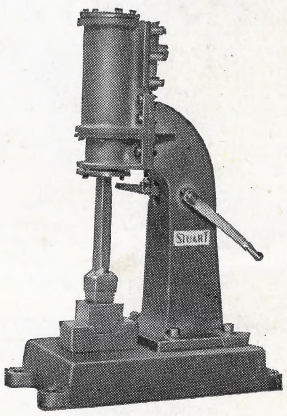

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